APOGEO SPATIAL

ELEVATING GLOBAL AWARENESS

THE APOGEO "Age of Disruption" SERIES:

Skybox Imaging p. 20

BlackBridge's RapidEye p. 26

Sensors & Systems *Interview with Scott Soenen, CTO*

> "No other provider in the market is delivering commercial high-res full-motion HD video and high-res imagery (from space)."
>
> –Skybox, *p 20*

> "It's really interesting to see these new players like Skybox and Planet Labs. We're very excited about seeing these new potential partners, or seeing in what ways users can leverage the different data sources."
>
> –Scott Soenen, BlackBridge, *p 26*

FORMERLY Imaging NOTES

PROUD MEMBER OF LMA LOCATION MEDIA ALLIANCE

[Spring 2014 / Vol. 29 / No. 2]

Cover image is Lake Saroma, Japan, showing ice melt on March 30, 2014. See pages 6, 20 and 21 for more information. Image courtesy of Skybox Imaging.

APOGEO SPATIAL

Apogeo Spatial communicates the power of geospatial tools and technologies in managing the world's environment and scarce resources, so that the global population has the security of water, food and energy.

APOGEO PROVIDES VISUAL INTELLIGENCE elevating global awareness for the long-term sustainability of the planet and people. Business, government and academic professionals find here the information—and inspiration—for using geospatial tools to build a more sustainable world. With the fresh, relevant insights from expert contributors, stunning visuals and clear examples of the technologies, those who make critical business and policy decisions about the world's resources will understand the visual power of remotely sensed data.

Apogeo Spatial is an important link to the education and academic communities to show young people the impact of geospatial technologies in helping to solve challenging problems facing humankind and to know more about the unknowns.

Mark Brender
Director / DigitalGlobe Foundation

It is exciting to see *Apogeo Spatial* and its focus on ecosystem health. Our ecological and social challenges are intertwined and global. Utilizing the view from space will assist us in addressing large-scale ecosystems health and in determining the actions that will be generative and effective in healing the planet. *Apogeo Spatial* is bringing critical ideas and tactics for utilizing geospatial tools to solve global issues.

Anita M. Burke
Founder / The Catalyst Institute

The *Apogeo Spatial* launch is very exciting for those of us working in the geospatial field. *Apogeo* is a leading source for understanding how global-scale issues can be addressed using geospatial information and tools. It is becoming a primary means to keep up with the revolution in spatial information.

Bill Gail, PhD
CTO / Global Weather Corporation

Apogeo is providing game-changing insights for a game-changing sector.

Nancy Colleton
President / Institute for Global Environmental Strategies
Executive Director / Alliance for Earth Observations

The Parana River follows the border of Paraguay (to the north) and Argentina in South America. *The Lagunas y Esteros del Ibera?* wetlands lie to the south of the river and cover more than 7,456 square miles (about 12,000 square kilometers) in the Argentine province of Corrientes. The wetlands consist of marshes, swamps, and lagoons, of which nearly 60 percent are permanently inundated, and have remained largely untouched by human activity. This image was taken with the L5 TM sensor on Jan. 21, 1992. Lat/Long is -27.511/-56.849. Image courtesy of U.S. Geological Survey, Earth Resources Observation and Science Center.

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APOGEO SPATIAL

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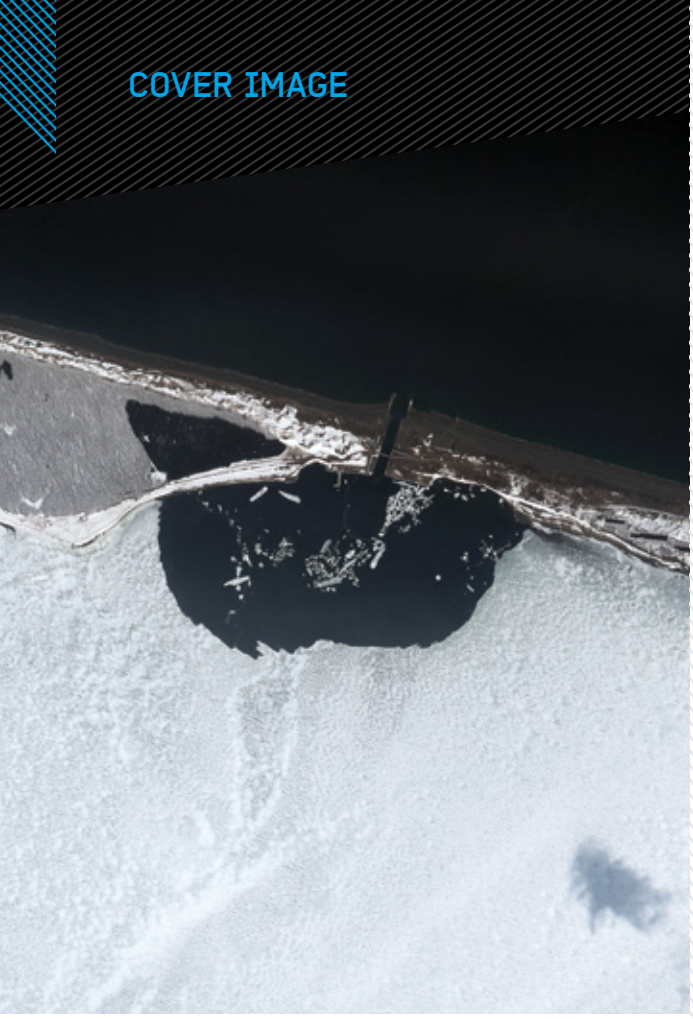
AGE OF DISRUPTION SERIES

COVER IMAGE



Lake Saroma, Japan

FROM SKYBOX

SKYSAT-1 CAPTURED THIS IMAGE OF LAKE SAROMA, Japan on March 30, 2014, as part of a series of collects throughout the month of March.

Tidal movements between Lake Saroma and the Sea of Okhotsk keep ice from forming around the narrow strait seen in the image, and cause the lake ice to periodically break apart, creating the circulating floes seen in the images. Rising springtime temperatures also melt the snow that's accumulated on the lake ice, and create the pattern of small melt ponds that become more and more visible on the ice surface as warmer temperatures arrive.

Skybox Imaging is featured in a Q&A on page 20, with several additional images. Image courtesy of Skybox Imaging.

APOGEO SPATIAL

Formerly Imaging Notes

[Spring 2014 / Vol. 29 / No. 2]

MISSION

Apogeo Spatial communicates the power of geospatial tools and technologies in managing the world's environment and scarce resources, so that the global population has the security of water, food, and energy.

PARTNERSHIPS

Apogeo Spatial has a partnership with Secure World Foundation (www.swfound.org) and is a founding member of the Location Media Alliance (www.locationalliance.net).

Apogeo is affiliated with the Alliance for Earth Observations, a program of The Institute for Global Environmental Strategies (www.strategies.org).

EDITORIAL CONTRIBUTIONS

Apogeo welcomes contributions for feature articles. We publish articles on the remote sensing industry, including applications, technology, and business. Please see Editorial Guidelines on www.apogeospatial.com, and email proposals to editor@apogeospatial.com.

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The Age of Disruption Continues...

Myrna James Yoo
Publisher and Managing Editor *Apogeo Spatial* and *LBx Journal*
Owner Blueline Publishing LLC

DEAR COLLEAGUES,

Finally, after years of discussion and requests, with the official endorsement of the U.S. Intelligence Community announced at the GEOINT Symposium in April, the changing of DigitalGlobe's commercial remote sensing license with NOAA seems inevitable. While not yet approved by The White House, this change would certainly benefit DigitalGlobe by allowing them to participate in the global marketplace by selling data with 25-cm resolution (vs. the current limit of 50-cm), primarily competing with Airbus Defence and Space and with the aerial photography companies.

As we continue covering The Age of Disruption and how companies are changing the economics of Earth observation, this issue features interviews with two smallsat companies, BlackBridge and Skybox. BlackBridge purchased the five-smallsat constellation of RapidEye in 2011, and has now completed the transition to include delivery on a cloud-based system with focus on multi-temporal change detection applications and broad-area mapping. This interview with CTO Scott Soenen and *Sensors & Systems* (our Location Media Alliance partner) is on page 26.

Skybox launched their first smallsat with the first commercial high-res video from space, plus electro-optical imaging, in November 2013. The company was founded by four students at Stanford University who met in a graduate-level class in 2008, where they wrote the first business plan for Skybox. Their story began there, and our story begins on page 20.

Interviews with both Planet Labs and PlanetiQ are coming up in our Summer issue.

"Calm technology" is a passion of Esri's Amber Case, interviewed by Natasha Léger of LMA partner *LBx Journal* on page 40. Location data is at the heart of the connected world. Everything is connected. Calm technology offers ways for this to be more manageable for us, as humans.

We are privileged to publish a summary of Euroconsult's first ever report on Earth Observation Data Distribution by Adam Keith, Director of Space and Earth Observation. Summarized are distribution mechanisms, such as partnering and forming alliances; geographic distribution of distributors; and factors influencing sales. The summary begins on page 16. The full report is available for purchase on the Euroconsult website: http://bit.ly/QNpbFO.

Airbus Defence and Space officially launched at the GEOINT Symposium the much-anticipated WorldDEM Digital Elevation Models of the entire Earth, after years of collecting radar data with twin satellites TerraSAR-X and TanDEM-X. We covered this in our Fall 2013 issue, which can be found here: http://apogeospatial.com/elevating-information/.

Hexagon has launched a new division, Hexagon Geospatial, after several acquisitions of companies. On page 32, read about how The Netherlands, a country with unique geographic needs including much reclaimed land (polders), is using geospatial data, such as Nijmegen municipality, which is using geospatial tools and data for several projects, including moving from 2D to 3D for change detection. Many users of the data are non-GIS experts.

Working towards solving global problems is the Group on Earth Observations (GEO), to which the Secure World Foundation was elected as a Participating Organization, announced at the January 2014 GEO Ministerial Week in Geneva. Secure World Foundation held a workshop, "Disasters Risk Reduction and Earth Observations: A GEOSS (Global Earth Observation System of Systems) Perspective," which brought together 15 speakers from around the world to share on advancing GEO goals, such as data sharing, user engagement, and space applications in service to humanity. More information is on page 10, in the Secure World Foundation Forum.

The importance of the worldview that these companies and organizations provide is revealed in these words from Socrates:

"Humanity must rise above the earth, to the top of the atmosphere and beyond. For only then will we understand the world in which we live."

Beyond Disaster Response

REPORT ON THE "DISASTER RISK REDUCTION AND EARTH OBSERVATIONS: A GEOSS PERSPECTIVE"

Laura Delgado López
Project Manager
Secure World Foundation
Washington, D.C.
www.swfound.org

FROM THEIR VANTAGE POINT IN ORBIT, EARTH observation satellites offer a unique perspective in the aftermath of a natural disaster. For emergency responders and decision makers on the ground, when these data are combined with information from other space-based assets, such as position, navigation and timing (PNT) and communication satellites, they provide critical intelligence for the response, recovery and rebuilding phases of disaster risk reduction and management (DRRM). Following human and environmental disasters, such as Superstorm Sandy that struck the United States in 2012 and the 2010 earthquake in Haiti, these assets enable DRRM professionals to efficiently plan rescue operations and save lives, accurately assess damages, and ensure that resources are delivered as quickly as possible to communities in need.

Increasingly, Earth observation data and other information tools are helping disaster management practitioners take action even before disasters occur. As integrated data sources and analysis tools help researchers understand the conditions that lead to these events, experts are beginning to identify sources of risk and plan ahead, making decisions that can ultimately save lives and reduce mounting material and economic losses. How can Earth observations data be better integrated to support all phases of the disaster management cycle? What challenges limit the ability of practitioners—particularly in developing countries—to use these data in a timely fashion?

Questions such as these were raised by DRRM experts and practitioners during a one-day workshop organized by Secure World Foundation (SWF) and the Group on Earth Observations (GEO) in January 2014 as part of the GEO Ministerial Week in Geneva, Switzerland. Through its over 150 partners, GEO is working to coordinate global Earth observations from space in a Global Earth Observation System of Systems (GEOSS) and to expand the use of satellite imagery and surface data to address common challenges.

Editor's Note:
An interview with GEO Secretariat Director Barbara Ryan appeared in our Summer 2013 issue.

By supporting risk modeling efforts, open access data policies and practices, real-time data sharing, global coordination in warning systems and standardized procedures and practices, GEO is furthering international collaboration in the understanding, response and mitigation of a variety of natural hazards, from earthquakes and tsunamis, to wildfires, floods and volcanoes.

During the Ministerial Week, GEO adopted the Geneva Declaration, renewing its mandate through the year 2025 and outlining a vision for this second phase of implementation. Among the efforts underway is the recently-created Working Group on Disasters of the Committee on Earth Observation Satellites (CEOS), the space coordination arm of GEO, which has established pilots and regional demonstrations to improve the use of Earth observations for multi-hazard, end-to-end disaster management.

As an acknowledgement of SWF's efforts to advance GEO goals, including data sharing, space applications in service of humanity and user engagement, SWF was honored with election as a "Participating Organization" during

the GEO Plenary. The "Disasters Risk Reduction and Earth Observations: A GEOSS Perspective" workshop is the result of SWF's first collaboration with the GEO Secretariat. Over 70 participants attended the event to hear from 15 speakers from all over the world share progress on different regional and international initiatives and exchange views on challenges and opportunities.

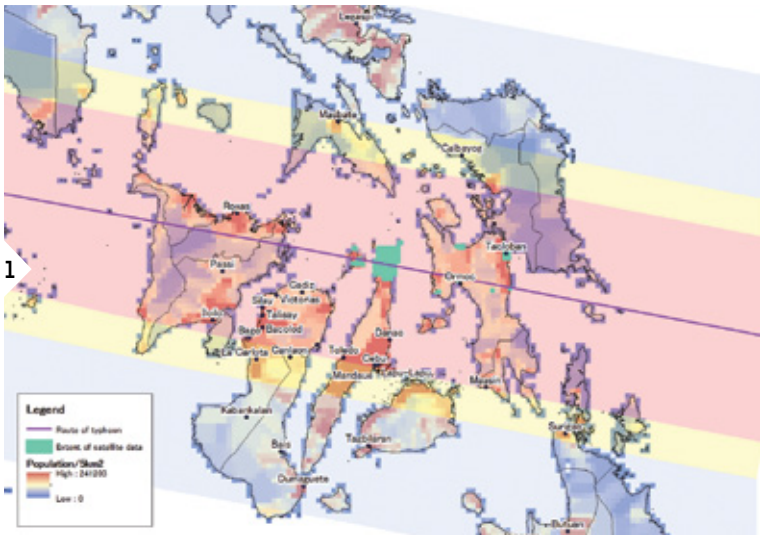
In her opening remarks, GEO Secretariat Director Barbara Ryan emphasized how these efforts continue the important task of linking data, information and services to users. Better understanding user needs was one of the key themes of the day. One of the challenges identified in the discussion is lack of consistent support for the necessary investments to incorporate data into national decision-making structures.

Several presenters, including Pedro Basabe from the UN Office of International Strategy for Disaster Reduction (UNISDR), noted that despite greater awareness of the role of space assets and Earth observations in DRRM, there is a need to better communicate the critical role of these data in risk management, particularly in understanding hazard and exposure. Massimo Cocco, from the European Plate Observing System, emphasized the need for metrics to measure use of the data in order to demonstrate value to the agencies investing in critical infrastructure.

Another important issue that was raised during the side event, and echoed in exchanges at the GEO Plenary, is data accessibility. Free and open access to data, one of the principles promoted by GEO, is not sufficient if data are not discoverable or easily accessible. With real-time data integration as a growing need to enable fast response, there is a trade-off between providing simple information quickly and providing more complex and detailed information in the weeks following the disaster.

Participants during the day-long workshop further noted that even if data are readily available and accessible, decision makers may lack the ability to act on the information, a concern that is particularly relevant in developing countries. Continuous user engagement is therefore critical to understand how information is being used and to assess limitations and lessons learned.

As a case in point, Yusuke Muraki from the Asian Development Bank (ADB) described the impact of challenges like these in the bank's use of satellite data for damage assessment in the aftermath of Typhoon Haiyan (Yolanda), which struck the Philippines in November 2013. ADB accessed available data from several sources, including the International Charter "Space & Major Disasters," which has been activated 400 times in the last 10 years and is one of the success stories in DRRM.



◀ **FIGURE 1.** Map of the Philippines showing the extent of satellite-based maps available through the International Charter "Space & Major Disasters" (circled and highlighted in light blue) as of November 19, 2013, with the route of the typhoon (purple line), demonstrating the extent of the damage that responders could not assess with available data. Source: Asian Development Bank.

In this case, however, ADB found that the data provided through the Charter were insufficient to cover the affected area and that the window of availability, limited to the immediate response phase, was too short. The case study, which also illustrated local challenges for information utilization, demonstrated that opportunities exist for the development of data provision mechanisms to address other phases beyond immediate response. See ***Figure 1***.

The SWF-GEO side event was successful in bringing together DRRM practitioners, experts and users from around the world to exchange ideas about ongoing and future efforts to improve global understanding and response to natural disasters. In the context of GEO's renewed mandate for the coming decade, the discussion illustrated areas of opportunity to continue advancing timely and knowledge-based decision making for a rapidly growing community of users all over the world. ∧○

Prof. Hans-Peter Plag, PhD
Climate Change and Sea Level Rise Initiative
Old Dominion University
Norfolk, Va.
www.odu.edu/research/initiatives/ccslri

Risk Management

CLIMATE VS. CAR CRASHES

IN MY LAST COLUMN, I QUOTED A question posed to me by a young student: "What would you like to tell your twenty year old self?" she asked after having listened to my lecture on the challenge of climate change. I have been thinking about this question since then.

At the 14th National Conference and Global Forum on Science Policy and the Environment,[1] held on January 28-30, 2014, in Washington, D. C., I had the pleasure to listen to Richard Alley's opening keynote,[2] delivered in the inspiring and entertaining way he always talks about probably the most threatening challenge to humanity since the eruption of super-volcano Toba in what is now Indonesia about 75,000 years ago, or the "Black Death" in Europe in 1348-50: climate change. He talked about the effort we make to prevent–and to be prepared for, if we cannot prevent–the low-probability, high-impact event of a car accident: seat belts, a frame that protects the passengers, air bags in all possible places, intelligent brakes, stabilizing systems, and, most recently, anti-collision systems and cars that can anticipate accidents that are about to happen and take over to protect the failing driver.

Alley asked why we are not willing to make the same effort to reduce the risk associated with climate change. Listening to him, I realized that the comparison of car accidents and climate does not capture the full picture, because it does not consider the probability of a person being killed by car accidents or impacts resulting from climate change. In considering these probabilities, we may find the answer to the student's question: Taking a risk-based approach, we can ask the question of what will be the most likely cause of premature death for someone who is twenty today?

Let me look at the role climate change may play. We are fairly certain that climate change will continue to happen. Todd Sanford and colleagues concluded that no matter what we do, we are committed to an increase of 2 degrees C by 2100.[3] Even this moderate increase will have severe implications and very likely will cause more premature deaths than the roughly 1.5 million people who die every year globally in car accidents. Already today, we see a rapidly increasing potential for local climate events having global consequences, including the triggering of social unrest,[4] and the aggregation of extreme weather-related events in the last few years has been attributed to climate change.

Looking at more severe scenarios of 3-4 degrees C by 2100, we can expect that the number of premature deaths caused by these scenarios will exceed any of the human-caused atrocities we know of, and it will be comparable to a major asteroid hitting our planet or an extreme volcanic eruption taking place. 75,000 years ago, Toba killed about 60% of the global population. James Lovelock estimates that by 2050 the planet's carrying capacity will be down to 1 billion people,[5] which would lead to some 80% of the global population experiencing a premature death.

Let's be very conservative and assume that there is a 10% risk of a 4 degree C increase by 2100 (remember, the IPCC considers anything between 1-4 degrees C as likely) and let's further assume that for this trajectory, by 2050, 2 billion people will die prematurely because of climate change impacts, mainly extreme food scarcity. For any person living in 2050, this is equivalent to a 2-3% chance of a premature death because of climate change impacts. This is a very conservative estimate, but still much higher than any other single

cause of premature death. Of course, the risk is not distributed evenly over the globe, and people living in the poorer part of the world have a much higher chance to die prematurely… What does this tell us about the environmental justice of climate change?

In a recent report, the National Research Council (NRC) looked at the probabilities of rapid climate change impacts,[6] and they could not rule out that climate change could be much more abrupt than the IPCC assessment reports seem to suggest. The climate history documented in a broad geological archive provides ample evidence of rapid and large changes in past climates, which happened whenever a tipping point was crossed. The current changes have the potential to push the climate system again across tipping points with unpredictably large impacts. The NRC sees the necessity of implementing "Abrupt Climate Change Early Warning Systems" (ACEWS) that could alert us into action at the onset of such rapid changes.

Unfortunately, climate variability might push us over such tipping points without any sufficient warning time.[7] But even if we have sufficient warning time, how would we react to such early warnings? Studies using agent-based models seem to suggest that as we are getting closer to tipping points, we are able to do what is necessary and possible to stay away from those boundaries.[8]

Humanity could, of course, take a very different trajectory based on dysfunctional behavior exhibited many times in the past: Some of the developed countries could make the decision that not all can make it and invest in weapons to make sure that it is the decision makers who survive. During the Spanish Flu, some countries closed down their borders and threatened to shoot anybody trying to cross the border. This option is of course open to us to avoid those running out of water or living in areas with unbearable heat waves from entering the regions that are more moderate in climate and blessed with water–regions that Lovelock identifies as the lifeboats for humanity.

What would I want to tell my twenty year old self? That the most likely single cause of premature death for my younger self is one or another impact of climate change. That if you worry about anything at all and want to do something to reduce your worries, you should focus on what causes climate change and do everything you can to mitigate climate change and to prepare for what cannot be mitigated.

I also would want to tell my twenty year old self that we as a species have to make a decision on the future we want for humanity: The one of "Independence Day," where a united humanity follows a president who states, "We will not go quietly into the night! We will not vanish without a fight! We're going to live on! We're going to survive!" or the hopeless, depressing emptiness of "The Road," based on Cormac McCarthy emotionally shattering tale of a post-apocalyptic world with no hope left for the survivors. A clerk in a bookstore described this book to me as the most elegant way to make yourself deeply depressed.

People like Naomi Oreske, who have been arguing for an evidence-based approach to a better future for a long time, increasingly see the end of Western civilization.[9] I would want to shout to my younger self that you are living at the beginning of a period that will turn out to be a crossroad for our civilization and that what you do, what your neighbor does, what your group does, matters: you are determining civilization's future, which will be somewhere between the hopes of "Independence Day" and the devastation of "The Road." Nothing less! Your choice.

Take responsibility. That is what I want to tell my twenty year old self–and also my much older self. ∧♂

Footnotes:

1 http://www.buildingclimatesolutions.org/

2 Alley, R., 2014: Keynote address, NCSE's 14th National Conference and Global Forum on Science, Policy and the Environment, "Building Climate Solutions," Arlington, Va., January 28-20, 2014.

3 Sanford, T, Frumhoff, P. C., Luers, A. and Gulledge, J., 2014. "The climate policy narrative for a dangerously warming world." *Nature Climate Change*, 4, 164-166.

4 Werrell, C. E., Femia, F. (eds), 2013. "The Arab Spring and Climate Change - A Climate and Security Correlations Series." Center for Amercian Progress, Washington, D.C.

5 Lovelock, J., 2009. *The Vanishing Face of Gaia.* Basic Books, New York.

6 See http://www.nap.edu/catalog.php?record_id=18373.

7 Lenton, T. M., 2014. "Tipping climate cooperation." *Nature Climate Change*, 4, 14-15.

8 Barrett, S., Dannenberg, A., 2014. "Sensitivity of collective action to uncertainty about climate tipping points." *Nature Climate Change*, 4, 36-39.

9 Oreskes, N. and Conway, E. M., 2014. "The Collapse of Western Civilization: A View from the Future;" Columbia University Press.

QUARTERLY LOCATION BUSINESS NEWS

Here are the most interesting or important articles from the Web, according to *Location SmartBrief* readers:

LOCATION ECOSYSTEM

1. **NGA to launch geospatial intelligence platform to integrate data** 03/19/2014

   The National Geospatial-Intelligence Agency will create a platform for intelligence analysts to immediately access all of the agency's data and examine multiple layers of information about a single geospatial point at a time, said agency director Letitia Long at the GEOINT Symposium. The platform, called Map of the World, will also integrate other information such as social media and other data to form a more complete intelligence picture. "In the past, you had to access multiple databases and search by hand for hours, sometimes even days, to find our information. That doesn't cut it in our rapidly changing world," Long said. http://bit.ly/PMVK5D

2. **Ads will make location-based services worth $3.8B in 4 years** 04/02/2014

   The market for location-based services in North America will reach nearly $4 billion by 2018, according to Berg Insight. Mobile location services are projected to grow at a compound interest rate of 16.1% per year, fueled primarily by advertising. Berg Insight's Andre Malm said, "Revenues are far from evenly distributed as major players including Facebook and Google with broad audiences have attracted the majority of ad spend." http://bit.ly/1frVViN

3. **AlterGeo's location data to be used to assess credit-worthiness** 04/23/2014

   Several banks in Russia have signed a deal with AlterGeo, a hybrid positioning system that uses Wi-Fi, WiMax and GSM among other technologies to create a detailed picture of the user's whereabouts when that person checks in via applications or signs up for an online discount. The location data AlterGeo collects will be used in a process dubbed "geo-scoring" to assess whether a loan applicant is trustworthy. http://bit.ly/1fo0jjb

INDUSTRY APPLICATIONS

1. **Twitter knows what you're drinking** 04/09/2014

   A study of location data for alcohol-related tweets shows patterns of booze consumption around the U.S. in this set of maps. Wine appears to be more popular on the coasts, while beer is popular in the Midwest and parts of the South. http://bit.ly/S4yRN2

2. **Location data maps path of great white shark crossing Atlantic** 03/12/2014

   Marine biologists have successfully tracked a female great white shark across the Atlantic Ocean using a tracking device that transmits location data every time the shark's dorsal fin rises above the surface of the water. http://bit.ly/1h8OliV

3. **USGS seeks to create LiDAR-based map of U.S. elevations** 03/05/2014

   The U.S. Geological Survey is collecting high-resolution elevation data for the country as part of a project to create baseline 3D maps for a range of uses including monitoring forest biomass and crop health. http://bit.ly/1rzDxVj

BUSINESS AND STRATEGY PLANNING

1. **Microsoft building cloud-based GPS location system to save phone batteries** 02/26/2014

   Microsoft is developing an experimental cloud-based system for gathering satellite GPS data in an effort to reduce some of the battery drain on smartphones that comes from constantly collecting signals. The system works by offloading GPS data to a cloud server that processes it in conjunction with other information such as cell tower location to infer the phone's position. http://bit.ly/1mTlU5t

2. **Location technology is set for unprecedented growth** 03/05/2014

   The U.S. is headed for a boom in technology that uses location context to enhance real-life experiences, said panelists and presenters at the Street Fight Local Data Summit. In particular, location data is poised to see growth in indoor technologies as indoor positioning systems such as Apple's iBeacon continue to improve. On the search front, companies such as Goodzer, Retailigence may use their inventory-tracking technologies to create local comparison shopping or delivery services, Damian Rollison writes. http://bit.ly/1rzDxVj

3. **The growing role of location data in retail** 03/12/2014

   Retailers are using location information to analyze diverse areas of their businesses, including how to improve store design to maximize sales, how to measure the effectiveness of marketing campaigns and how to improve operations, writes Tony Costa. Businesses will also increasingly use location data to provide discounts and preferential status to customers based on their behaviors. "Just as Web analytics is an essential tool on the Web, location analytics will become a must-have for designing, managing, and measuring offline experiences," Costa writes. http://bit.ly/1h8OliV

Sensors & Systems

FOLLOWING ARE THE TOP TEN NEWS STORIES for each month prior to this issue as recorded via visitor views to the daily updates on *Sensors & Systems* (www.sensorsandsystems.com). The stories at the top received the most views for the month.

JANUARY	FEBRUARY	MARCH
Environment Canada's "Yellow Submarine" Aids Water Quality Research in Lake Winnipeg http://bit.ly/PMjmqX	URISA's Vanguard Cabinet Introduces Mentoring Program http://bit.ly/1lr5dfi	3D Vegetation Library Delivers Advanced Models for Urban Design and GIS Professionals http://bit.ly/QSGHZ7
3D Mapping 3D Modeling Market Poised to Reach $7.7 Billion by 2018 http://bit.ly/1k6Hehc	Satellite Images Reveal U.K. Flood Impact http://bit.ly/1tXA0Ew	UCLA Geographers Devise New Way to Calculate River Flows from Satellite Imagery http://bit.ly/1ivTMxc
Portugal Preps for Copernicus http://bit.ly/S3sBFj	"Geo: The Big 5" – Tackling the Big Challenges Facing GeoSpatial in 2014 http://bit.ly/1rH6f8N	Pitney Bowes Adds Enhanced Big Data Management Capabilities to Its Spectrum Technology Platform http://bit.ly/1ryZlAo
Call for Papers – Using Crowdsourcing to Further Earth Observation http://bit.ly/S3sOs3	Scientists Use Imagery Satellites to Spot and Count Whale Population http://bit.ly/1m4dyrY	exactEarth Release Tracking Data of the Search for MH370 http://bit.ly/1kn9VJM
Bluesky Purchases UltraCam Eagle with UltraNav http://bit.ly/1fKXD9T	The American Security Project Takes on the National Security Challenges of Climate Change http://bit.ly/1h8lsZM	Eco-Technologists Launch Global Citizen Science Project to Save Declining Bee Populations http://bit.ly/QSHiu1
Carbon Project Helps Connect Social Media to Satellites http://bit.ly/1iyMw95	Leica Geosystems and Airborne Hydrography AB Launch Next-Generation Multispectral LiDAR Solution for Shallow Water Surveys http://bit.ly/1nAssWH	New Mapping Method for 'Green Infrastructure,' Europe's Vital Natural Areas http://bit.ly/1plqKV3
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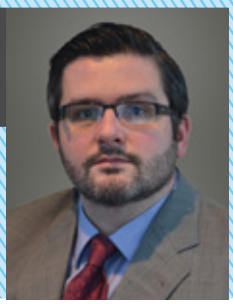
First Data Distribution Report from Euroconsult

Differing End-User Requirements Necessitate Need for Diverse Data Distribution Strategies

BY ADAM KEITH / DIRECTOR / SPACE AND EARTH OBSERVATION
EUROCONSULT / MONTREAL, CANADA / WWW.EUROCONSULT-EC.COM



Data distributors have established themselves as a key component of the Earth Observation (EO) value chain and an important partner of EO satellite operators in order to disseminate data to the largest number of end users possible. This is particularly apparent in accessing developing regional markets and being able to do business locally with government and private end users.

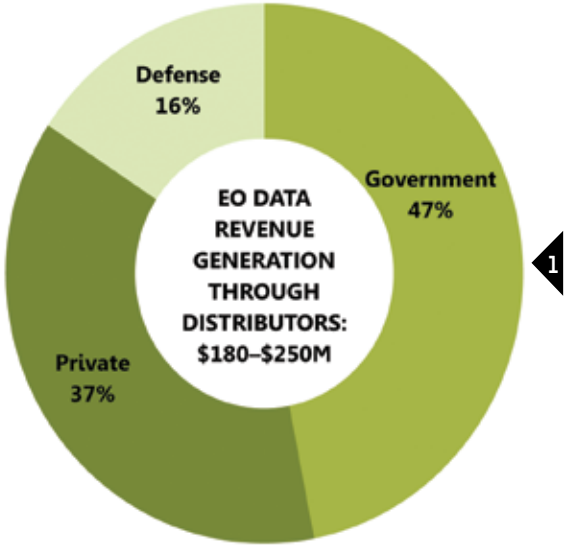
According to Euroconsult's new research report, "Earth Observation: Data Disribution – Profiles, Strategies & Trends," an estimated 12-17% of the $1.5 billion commercial data market flows through the distributors of EO satellite operators. While this percentage may seem low, it should be recalled that the majority of the total market is to defense end users (65%) who usually prefer a more direct approach to receive imagery. Business for the data distributor reflects this, with a far greater emphasis on enterprise (civil and private markets). See ***Figure 1***.

Revenue through data services from the distributors is first from civil governments, totaling 47% of distributor data business. This highlights the need to be local in accessing civil contracts, an important consideration given the growing demand globally for EO solutions – particularly in fast-growing regions (for instance in Southeast Asia, Latin America) with a strong civil mandate to support resource monitoring, engineering and infrastructure projects, etc.

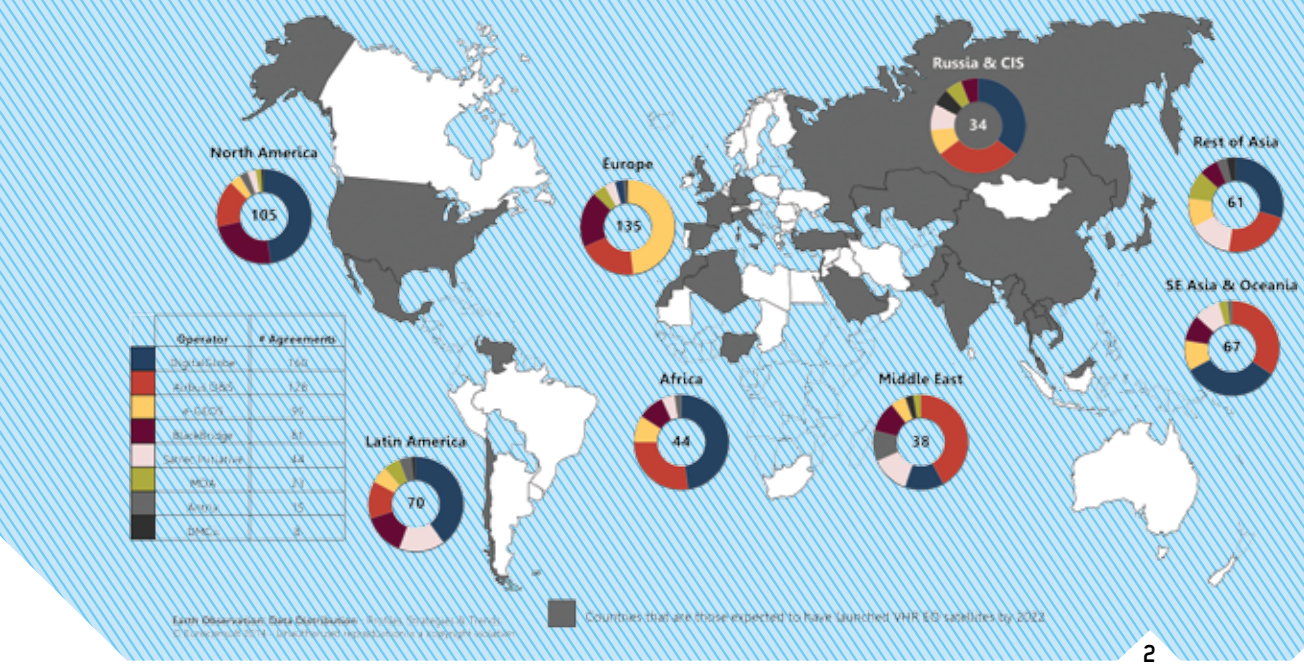
Data provision to the largely data-agnostic private sector through distribution is also disproportionately higher than the total data market, representing 37% of the distributors business. The relatively small figure of 16% data revenues associated with defense users demonstrates the more direct approach preferred by this user community. Most operating companies with very high-resolution satellites offer direct receiving stations (DRS) solutions to defense end users in order to meet their requirements of short delivery time, and secure, continuous data supply with degrees of autonomy in satellite tasking and data acquisition.

EO satellite operators recognizing the different procuring attitudes of end-user sectors are quick in establishing partnerships with distributing companies. As of today, over 550 agreements are in place between operating entities and data distributors globally. In the past, commercial operators significantly

DATA DISTRIBUTOR'S REVENUE BREAKDOWN



▶ FIGURE 1. Data Distributors Customer Mix. Note that the low number for defense is misleading, because most defense users do not use distributors to get their data.



▲ FIGURE 2. Global Mapping of Distribution Networks Chart

developed their networks in fast-growing regions that demonstrate a strong potential for commercial growth but with limited national high-resolution data supply. Operators have since shifted their focus to re-emphasize the home markets; this could indicate that distribution networks that are currently in place in regions like Latin America, Africa, and Southeast Asia and Oceania are now sufficient to address these regional markets. See ***Figure 2***.

The clear advantage for an operator in establishing partnerships with data distributors is access to local markets. As previously stated, civil government is the primary customer sector for the distributors, and, since governments are nominally mandated to support its national industrial base, this is not viewed as a surprise. However, it is not just a question of "being local." Further advantages include understanding local customs and procedures, including the language barrier; and being present in order to monitor Requests for Proposals (RFPs), and to lobby the procurement departments of the administrations ahead of the RFPs' issuance. In certain cases, the RFPs are reserved for local companies.

In many administrations, the suppliers have to be referenced first to be allowed to place a bid. Such referencing may represent time and money for the operating company. Distributors can more easily filter the requests from potential customers and, therefore, save significant time for the operator's customer services.

Distributors also stress the importance of being in "proximity" to end users. That proximity is not only geographical, but also in terms of expertise and technological culture: sharing the same vocabulary and understanding the end user's actual usage of the data. Further motivation for the operators to establish a distribution network includes securing guaranteed revenues from exclusive resellers, implementing a presence within a country without dispatching their own staff, and obtaining access and clearances to foreign national governmental business.

Operators tend to organize their distribution networks in regional coverage, with a higher density of resellers over active national markets. In such cases, they may even assign several vendors to the same geographic territory but with different market segments, thus avoiding the creation of internal competition within their networks. Although specifics vary between the satellite operators, a broadly similar approach is taken.

Distribution mechanisms include partnering or forming alliances with:

- **Data Resellers:** They procure data from the operators and resell them to the end users. Their main value is in their proximity with the end user: whether they have a lobbying influence or are pushing for the suitable specifications from the customer, whether they speak the language and

know the customs of the end user, or whether it is simply that the end user statutorily has to buy from a local company.

- **Value-Added Resellers (VARs):** From the data they procure from the operators, they derive products, which they sell to the end users. Their value may reside in their capacity to offer an original product and/or in their proximity with the end user in a similar way to the data resellers.

- **Exclusive Distributors:** Commercial operators have included in their network data resellers or VARs that have a privileged status; they are committing to minimum buying. In exchange, several advantages are offered: closer support from the operator technical, marketing, and sales teams; higher discounts on the international price list; and the right to set up their own sub-distribution network.

- **Business Partners:** In synergy with the development of new big data and cloud and streaming technologies, the operators are starting to use such technologies to disseminate their data and promote their use. Products like those of Esri, Hexagon's ERDAS, and Pitney Bowes' MapInfo may propose to their GIS users streaming access to imagery databases; corresponding agreements with operators are de facto distribution agreements.

- **Direct Receiving Station Partners:** DRS contracts are considered to have the highest value and guarantees for the operator. They are mainly targeted toward defense users that require a greater level of data acquisition on demand and a degree of autonomous and secure access to data, and toward users requiring a very large quantity of data.

The data distributing companies themselves are predominantly small- to medium-sized structures. In total, 40% consider data distribution as their primary business. Other activities are connected to applications development, value-added products (such as Digital Elevation Models), or value-added services (such as change detection monitoring). Data distribution is seen as a way to meet customers' expectations and to complement their other business offerings. Areas of activities are spread over all EO market segments, though sectors, such as defense, and more emerging sectors, such as LBS, are underrepresented. End users in these domains wish to deal directly with the satellite operators, whether for confidentiality or cost-effectiveness reasons.

The primary reasons for why geospatial companies enter the data distribution business are to better respond to clients' needs and to be in a position to offer integrated solutions. The offer of a fully integrated solution reflects a wider EO trend in which users request a complete solution, or indeed the final information product. Any supplier taking care of ordering the data, processing it, and delivering a value-added product can build a more cost-effective offer and take a stronger market position than pure value-added companies buying data from a third party in order to build the service. In addition, data distribution companies that are also value-adding companies hold an added advantage of having in-house expertise on target application areas.

For these companies' data-sale business, three factors stand out in influencing sales:

- **Diversification in supply:** The time when users had to wait for the availability of IKONOS very high-resolution data or Spot 5 high-resolution data is gone. Acquisition capabilities in both very-high (sub-meter) and high resolution data have grown significantly with distributors having multiple choices in order to meet end-user demand.

- **Higher resolution:** Improving ground resolution provides a higher level of detail that has helped distributors create opportunities to serve new domains of applications, especially in replacing aerial photography with easier-to-get, cheaper satellite imagery.

- **Timeliness for delivery:** Recent improvements in producing and delivering data shortly after acquisition have opened the door to strong improvement of monitoring applications. Automation of production and delivery certainly also contributes to this success.

Despite these positives, however, challenges remain in the link between operators and distributing companies impacting both levels of the value-chain, in particular:

- **Licensing restrictions:** Many of the distributors' customers would like to purchase the ownership of the data so as to be able to do whatever they want with it (such as share with partners). National regulations imposed on the operators (such as the inability to sell sub-.5-meter ground resolution imagery) are considered further blockages for sales and services development.

- **Competition from operators:** Some distributors have the feeling that operators may favor direct sales rather than utilization of the network. Competition is not only focused on the Web portals of the operators; certain operators, for instance, tend to answer large RFPs directly without going through their distributor.

Somewhat surprisingly, competition with national government systems is not viewed as a major concern. Indeed, national programs are seen more as stimulating the market than endangering the distributors' position, the main argument being that the national program increases overall data availability and provides access to further end-users, hence making the overall business more secure and more sustainable. However, although not all of countries launching EO satellites are commercializing data from the systems, some attrition in the national usage of commercial data could be expected.

Concerns do also remain on the intent of the respective national programs. Certain distributors are concerned with either low pricing of national EO program data, and even greater concerns would arise if the data were to become free, at least for national government users, which make up the bulk of distributors' customers. In such cases, the growing national competition could inhibit growth in certain sectors that can make do with lower cost data at lower ground resolution with less of a constraint on timely delivery. ∧♂

ABOUT THE REPORT

"Earth Observation: Data Distribution - Profiles, Strategies & Trends" gives an assessment of the distribution level of the Earth observation value chain. It is the first research report to explore the connection between operators and distributors, and the advantages and challenges in expanding the operators' geographical footprint and in reaching out to the largest potential number of end users through partnerships. It considers both the organization strategy developed by the satellite operators and the viewpoint of the distribution companies.

APOGEO Q&A WITH SKYBOX IMAGING

Skybox

First Video from Space

BY MATTEO LUCCIO / CONTRIBUTING WRITER
PALE BLUE DOT LLC / PORTLAND, ORE.
WWW.PALEBLUEDOTLLC.COM

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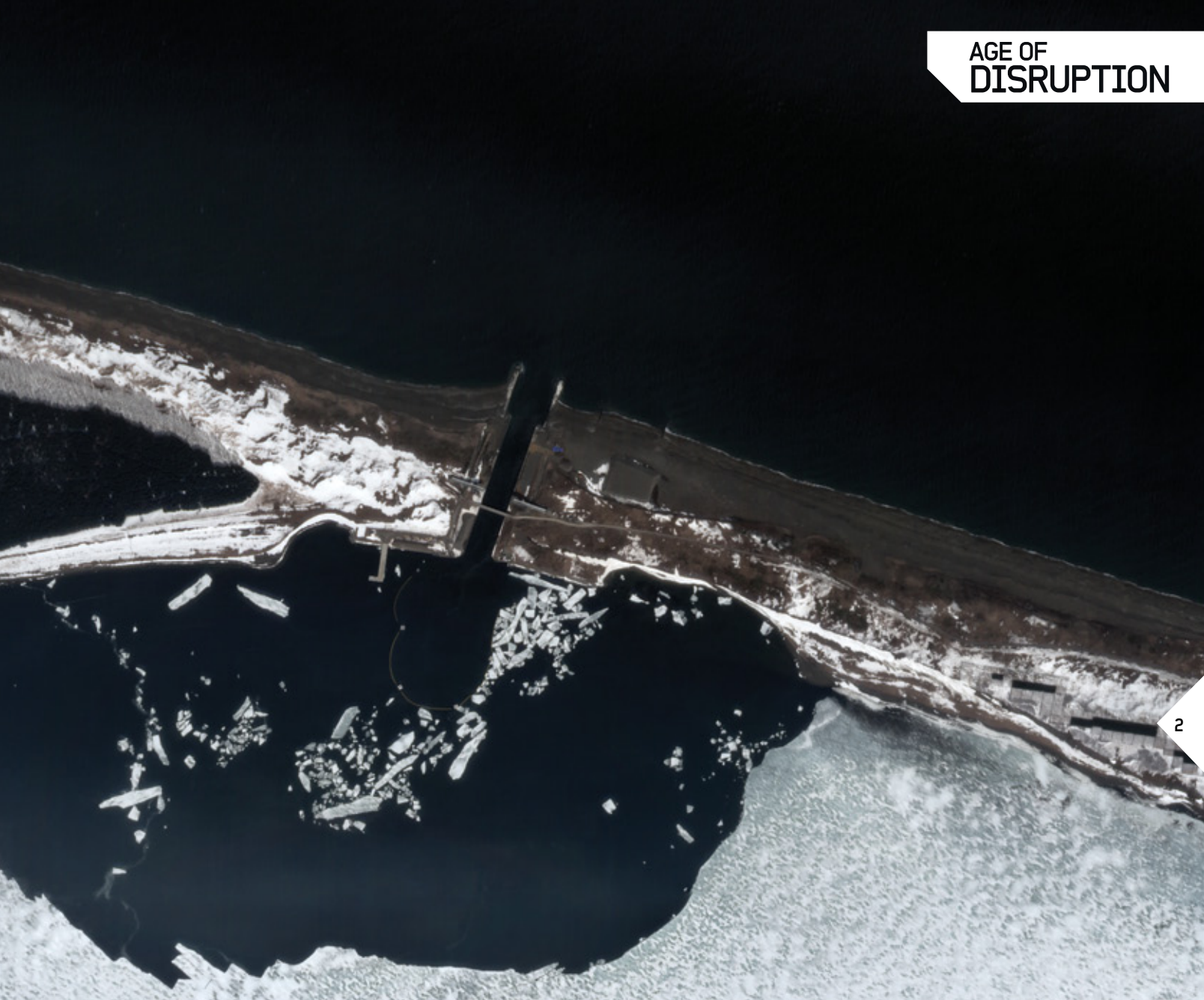
APOGEO *What is Skybox Imaging?*

SKYBOX Skybox is a data and analysis company that extracts information from satellite imagery. From the number of ships in the Panama Canal to the volume of oil in a Saudi refinery, we approach the world as one enormous data science problem with a focus on providing global businesses access to timely imagery, video, and analytics to help them make smarter, more informed business decisions.

We launched our first high-resolution imaging and video-capable satellite, SkySat-1, in Nov. 2013; SkySat-2 is scheduled to launch around the middle of this year aboard a Soyuz rocket, followed by SkySat-3, which is scheduled to launch in late 2014. Looking ahead beyond 2014, we are on track to launch our first block of six commercial high-resolution imaging and video-capable satellites from California's Vandenberg Air Force Base aboard an Orbital Sciences Minotaur-C launch vehicle. We plan to have our full constellation of 24 satellites in orbit within the next five years, at which point we will be able to revisit any point on Earth up to five to seven times per day.

The Skybox founders, Dan Berkenstock, Julian Mann, John Fenwick, and Ching-Yu

Editor's Note:
All images are from SkySat-1, which was launched in Nov. 2013.



Hu, met in a graduate entrepreneurship class at Stanford in 2008 where they wrote the first business plan for Skybox as part of the class project. We were incorporated shortly thereafter.

APOGEO *What sensors do your satellites carry? Who built them? Do you plan to add different sensors in the future?*

SKYBOX We completely designed, built, and tested our first two satellites in house: SkySat-1 and SkySat-2. Over the last few years, we have designed a completely new imaging chain comprising high performance optics, sensors, and cameras.

↘ **Our satellites use a silicon carbide-based Ritchey Chretien telescope design, dramatically limiting complexity while simultaneously improving performance across a wide thermal range.**

↘ **SkySats utilize a ground-breaking two-dimensional staring sensor, in contrast to the traditional line sensors used in legacy systems. This improves image quality by acquiring large numbers of images that can be overlaid on the ground and dramatically reduces complexity in the spacecraft guidance, navigation, and control system.**

◀ FIGURES 1-2. Lake Saroma, Japan images clearly show ice melt in only 3 days.

◀ FIGURE 1. March 27, 2014

▲ FIGURE 2. March 30, 2014

We have designed our satellites in a configuration that allows us to easily add unique sensor modalities based on market demand as we scale the constellation. We recently announced our partnership with SSL/MDA, who will be manufacturing our next 13 satellites. We will continue prototyping next generation systems in house while leveraging SSL/MDA's manufacturing production capabilities.

APOGEO *At what altitude and inclination do your satellites fly? Why did you choose those values?*

SKYBOX SkySat-1 is in a 600-km sun-synchronous polar orbit, in Low Earth Orbit. SkySat-2 will be in about the same orbit. SkySat-3 and beyond will have propulsion onboard (provided by ECAPS), which will allow us to lower our altitude to achieve resolution closer to ~75 cm range.

APOGEO *What is the downlink bandwidth of your satellites?*

SKYBOX 480 mbps

APOGEO *Is your data radiometrically corrected?*

SKYBOX Our imagery is radiometrically-corrected, panchromatic, multispectral, and pan-sharpened image frames. Products include comprehensive metadata for advanced image processing.

APOGEO *Currently, what is your refresh rate for a given pixel on the ground? What will it be once your constellation is fully deployed?*

SKYBOX With one satellite, we can see any spot on Earth roughly once every three days. At scale, we will be able to see any spot on Earth five to seven times per day.

APOGEO *How will you deliver data to customers?*

SKYBOX It is a combination of direct distribution to certain customers as well as indirectly through our distribution partners.

APOGEO *What is your business model?*

SKYBOX We're uniquely focused on empowering global businesses to make better decisions on a daily basis with high-resolution (sub-meter), high-temporal imaging and derived analytics. No other provider in the market is delivering sub-meter imagery and high-res full motion HD video today. We have 3 products lines:

1. **Access:** Compact ground stations called SkyNodes enable customers to directly task satellites and downlink images from the constellation. Recently announced customers include EUSI, SIME, and JSI (Mitsubishi/Hitachi).

2. **Imagery and Video:** We sell subscriptions for high-resolution images and video to customers in agriculture, financial services, consumer mapping portals, etc.

   We collect both panchromatic and multispectral images. The multispectral bands are red, green, blue, and near infrared. We fuse the panchromatic images with the multispectral images to generate pan-sharpened color images that we deliver at 90-cm resolution.

   We collect panchromatic high-definition video, in clips up to 90 seconds long with 30 frames per second at a resolution of 1.1 meters.

3. **Analytics:** We sell analysis reports derived from images and video from the Skybox constellation combined with external data sources describing activity on Earth's surface, such as changes in oil storage tank volumes, car counting, and pre/post crises analysis.

APOGEO *How does your operation differ from that of new cubesat entrants?*

SKYBOX We're excited about the many emerging players who are taking advantage of low-cost commercial electronics in space as well as lower cost access to launch. Those two factors are going to drive a tremendous amount of innovation, investment, and job creation over the next decade. We are similar to Planet Labs and other emerging cubesat companies in that regard. Beyond that, we don't typically compare ourselves because we operate in completely different industries.

Our original business plan at Skybox used cubesats, but we found that the best quality imagery that the laws of physics would allow us to capture was similar to imagery with resolution of 10-15 m that is already freely available today.

That class of imagery is useful for observing large-scale ecological processes, such as coastline erosion and changes in geologic features. There is an important need for that type of data, which today is primarily served by freely available Landsat data covering Earth's complete surface every 17 days in a wide variety of spectral channels at very high radiometric precision.

At Skybox, we were driven by the idea of building a transformational data source with the potential to impact how billions of consumers, businesses, and governments live their daily lives. We quickly realized that doing so required something fundamentally different than the cubesats we had been designing. Understanding macro trends across our globe related to transportation, infrastructure, natural resources, and commodities requires being able to see the things that move on a daily basis, such as cars and trucks. In order to identify those things that resonated with leaders of global organizations, we knew that we had to design a spacecraft that could capture imagery at better than 1-meter resolution.

What we did not know at the time was that only a handful of governments and government-derived satellites had ever accomplished that before. Even more, we had to do it at a price point that would allow us to launch the more than 24 spacecraft in carefully designed orbits that would be required to see the places and things that matter on a very frequent basis.

To do this, we completely re-invented high-performance space imaging from a blank sheet of paper. We designed more than 20 complex boards from scratch providing high quality imagery capture and on-orbit processing; we developed completely new designs for radios, for complex systems for accurate pointing, and for a large number of other systems that cannot be ordered from any catalog. We also built a scalable and flexible ground data system in Hadoop that allows us to store, process, and publish satellite imagery in an extremely cost-effective way.

▲ FIGURES 3-4. Mahajamba, Madagascar on April 9, 2014, with Figure 3 shown in color infrared

APOGEO *What do you expect to be your most important or lucrative markets? Of the many new applications that are being made possible by the lower prices for Earth observation data and by the greater coverage and shorter refresh times, which ones do you expect to generate the most business for you?*

SKYBOX We see huge potential for helping the Fortune 500 enterprises monitor global supply chains and global infrastructure. We can help them answer questions that impact their businesses:

- Is there an encroachment on my pipeline? Is my remote facility secure?
- What is the extent of the environmental impact of my factories around the world?
- Where are the open evacuation routes after a hurricane?
- What are the corn crop yields?

▶ FIGURE 5.
Jeddah, Saudi Arabia, Feb. 26, 2014

A few examples of other applications include:

↘ Asset assessment and monitoring for insurance companies

In 2011, the United States suffered a total of $380 billion in property losses. Insurance companies can more accurately tailor their services by better understanding and predicting the associated risks. Timely satellite imagery and derived data can be used for risk modeling, underwriting, damage assessment, response/claims management, and monitoring high value assets (including refineries, nuclear power plant facilities, etc.).

↘ Port monitoring

Today, ports handle more than 90 percent of the world's cargo. Shipping companies, ship owners, cargo users and commodity traders currently face a tremendous amount of uncertainty regarding the movement and location of ships and cargo worldwide. The maritime industry would greatly benefit from cross-referencing currently available ship tracking data with responsive, sustained, and accurate satellite imagery of key maritime ports.

↘ Deforestation monitoring

With sub-meter resolution, Skybox can rapidly provide individual counts of trees burned in a forest, as well as video and alerts of slash-and-burn activities.

↘ Precision Agriculture

For many agricultural customers, it is cost-prohibitive today to monitor global crop health estimates on a global basis. We can provide crop yield estimates and vegetation health analysis on a crop row-by-row basis, instead of doing so for an entire cropland, enabling more accurate employment of fertilizer and irrigation.

↘ Natural disasters

First responders to natural disasters need immediate situational awareness about impacted areas. Not only do they need a rapid view from overhead, they need high enough image quality to efficiently interpret the impact of the disaster (collapsed buildings, closed roads, car movements).

↘ Conflict Area Monitoring

Humanitarian crises are ongoing around the globe, with new incidents emerging every day. We believe that our constellation's daily coverage with both still imagery and video will provide greater transparency into these hot spots. A few weeks ago, we captured several images and video of the violent riots in Kiev. More recently, we have been taking images and video in search of the missing Malaysia Airlines flight MH370.

APOGEO *Approximately how much do you charge for data and various information products?*

SKYBOX Over the last decade, there have been numerous Earth observation industry reports predicting substantial growth in the commercial imaging market. We have talked to hundreds of customers since our inception, and we have found that it has never materialized due to several factors, including the cost of high quality imagery, the difficulty in accessing high quality imagery, when customers need it.

We have designed our pricing model to directly meet the first two industry blockers. Even though we have not publicly released our pricing (we plan on doing so soon), what we can say at this point is that our pricing is simple and affordable. Our pricing sheet fits on half an 8½ x 11 inch page. Our licensing sheet fits on a single page; there are no hidden bells and whistles that make it difficult for our customers to buy imagery from us. We also see a great deal of opportunity in the future to open the market to new users by tailoring our basic pricing to fit the timeliness and area of interest of customers.

APOGEO *Will you develop specific information products for customers or is it up to them to develop the specific information they need from your raw data?*

SKYBOX Both. We will develop a subset of information products for customers and will let customers bring their algorithms to our data platform for their specific use cases.

APOGEO *When did you actually begin to deliver data to customers?*

SKYBOX We are delivering SkySat-1 imagery and video data to paying customers and deploying SkyNodes around the world. We have been selling imagery and video from SkySat-1 over the last few months. If you haven't already, check out our image and video gallery here: firstimagery.skybox.com.

APOGEO *What do you mean by "infinite analytics"?*

SKYBOX Thinking more long-term, we envision that by the end of this decade, the vast majority of the Fortune 500 will have the ability to make better business decisions on a daily basis using high-resolution imagery and analytics derived from imagery—whether to better understand how to manage their supply chains depending on port activity, or deciding how to irrigate their crops based on daily crop yield estimates on a parcel basis—all with the help of our satellite imagery. ∧♂

▼ **FIGURE 6.** Murmansk, Russia, March 31, 2014

BlackBridge Reinvents RapidEye

Expanding Niche in Broad Area Mapping and Change Detection

FIGURE 1.
Dublin, Ireland, collected May 27, 2012

The purchase of the five-satellite RapidEye constellation by BlackBridge has linked Earth observation capacity to a cloud-based system. *Sensors & Systems* (S&S) editor Matt Ball recently spoke with Scott Soenen, CTO of BlackBridge, about the integration process, and the company's inroads in delivering cloud-based services that focus on the insights gleaned from commercial satellite imagery. The conversation ranged from the company's investments to normalize their imagery for multi-temporal change detection applications, to the hosted services approach that enables ongoing monitoring of broad areas, as well as to the growing demand for such services.


Scott Soenen

S&S *Is the fairly recent rebranding of RapidEye as BlackBridge an indication that the integration of RapidEye imaging with your other services is complete?*

SOENEN Yes, we're at the point of steady state where the transition period is behind us. We're now growing the team, and introducing new product lines and solutions.

S&S *Could you walk through a bit of the transition, how the purchase of RapidEye came about, and how it was a good fit for your existing operations?*

SOENEN One of our big focuses of the transition was on integrating our operating groups in both Canada and Berlin, and also on integrating between the cloud services side of the business and the Earth observation side of the business. Our focus was to go to market as one team. Bringing these two groups together allows for some interesting combined solutions, with a focus on the geospatial industry, but also for bringing in some new concepts about what you can do with cloud services and imagery.

The whole idea of the integration of RapidEye was to introduce new products, some of which have rolled out this year. We also have a number of new imagery and cloud service product lines that we'll be bringing to market over the next couple of years. Aside from the integration, company name and new product pipeline, not much has changed for our network of partners and customers. We continue to have the same relationships with customers, and we are really starting to focus on expanding the products that we can offer them.

S&S *RapidEye came with a set number of customers. Were many of these German government customers, given the government's investment in RapidEye? What is the mix?*

SOENEN We really have a wide range of customers, particularly for the RapidEye set of products. The key industries or markets for RapidEye data are natural resources monitoring for forestry, agriculture, broad-area mapping and change detection. We certainly have German government customers, but we have government customers throughout the world. We have an international network of technology and sales partners, and I couldn't point to one type of customer that makes up the majority of our customers. We are pretty well diversified at this point.

S&S *Can you describe a bit more about the networking and cloud services business? Was much of that already focused on the geospatial marketplace, as I know you have been a custom solutions provider in the geospatial market?*

SOENEN Our networking and cloud services business is really less known in the geospatial industry. Certainly we've built up quite a knowledge base on that front through developing some of our own systems for our internal needs. We have

Editor's Note: This story is also published in Location Media Alliance partner *Sensors & Systems*: http://bit.ly/1hqm6B2. All images were collected at 5-m resolution by RapidEye satellites.

an extensive archive of satellite imagery, and we've learned quite a bit about how to architect cloud services for geospatial data. What we've done now is take the expertise that we've built in cloud services and bring that together with our expertise on geospatial data.

Previously RapidEye had a heavy focus on the value-added products and services business. We've really taken a step back now, and focused on bringing the industry-leading collection capacity of the RapidEye constellation to market and on using the cloud services to make that imagery easier to discover, share and use. What has made us successful is excellence in our customer service and working with our global network of partners.

S&S *What are some of these services that you've released?*

SOENEN The services recently released, and those that are coming, are focused on supporting broad-area mapping for analyzing vegetation over large areas and change monitoring. We've made some significant investments in enhancing the geometric accuracy of our ortho-imagery products to really enable pixel-to-pixel alignment for multi-temporal analysis for change detection. Now we feel we have the best dataset for countrywide, continental and even global monitoring. There really is no other system that has that capacity, so we're working to build these new services on top of that capacity.

Our monitoring programs for agriculture are a good example of this. These are subscription programs that provide monthly refreshed imagery for crop analysis through the growing season. We've combined our cloud services to give our customers every single image that we collect over the agricultural area, and the tools to search through that imagery base to either download on their servers for their own processing, or to leverage our cloud infrastructure for value-added processing. They can stream the imagery through our infrastructure, where we can also host their applications and processes to make that move from downloading a bunch of imagery to a desktop to pushing their applications and processes into the cloud next to the imagery archive.

We think that will be increasingly important as we see this move toward analytics services that requires a heavy volume of imagery and bandwidth. It's the only philosophy that will work as we move into the era of data mining or larger area monitoring applications–taking the workflows and moving them to the data in the cloud.

S&S *That sounds exciting! So you're talking about a full hosted service that could even be a branded dashboard for customers that runs all the image processing and analysis in the cloud?*

SOENEN That's absolutely what we're doing. We're starting to create a suite of tools based on Open Geospatial Consortium standards that users can leverage for streaming and processing. We're also providing the general cloud infrastructure for hosting their applications.

Another thing that our cloud system makes possible is dynamic imagery services that can be updated on-the-fly, and refreshed regularly so that the user can easily consume these images. We do all the data management within our cloud infrastructure. Another really interesting thing that I'd like to highlight is our Living Image services that we have available through Esri's ArcGIS Marketplace.

S&S *Talk a little bit more about multi-temporal analysis, and the steps that you've done for pixel-to-pixel alignment. Are these steps automated to serve the imagery more quickly, and is the change analysis also automated?*

SOENEN That's been our focus, to continue to maintain our throughput, which is up to 5 million square kilometers of collection capacity daily, and also improve our image alignment for all of the images within our archive. We're working with a number of partners to bring new change detection services to the market. You'll see those come out over the next year. The geometric accuracy is the foundation, so that was the first step.

S&S *The free Landsat imagery is another broad-area mapping sensor. Do you tie into that free imagery for any of your products or services?*

SOENEN I'm glad that you brought that up. For our agricultural service, we're also pulling together imagery from the Landsat archive, and making

▶ FIGURE 2. RapidEye Mosaic of Pakistan with cloud coverage of <1%. Timeframe of Collection: November 2010-December 2012

"It's really interesting to see these new players like Skybox and Planet Labs. We're very excited about seeing these new potential partners, or seeing in what ways users can leverage the different data sources. They could use our imagery for identifying areas of change, and then using these new low-cost, high-resolution platforms to focus in, they could collect video or still images of these areas where we've identified change."

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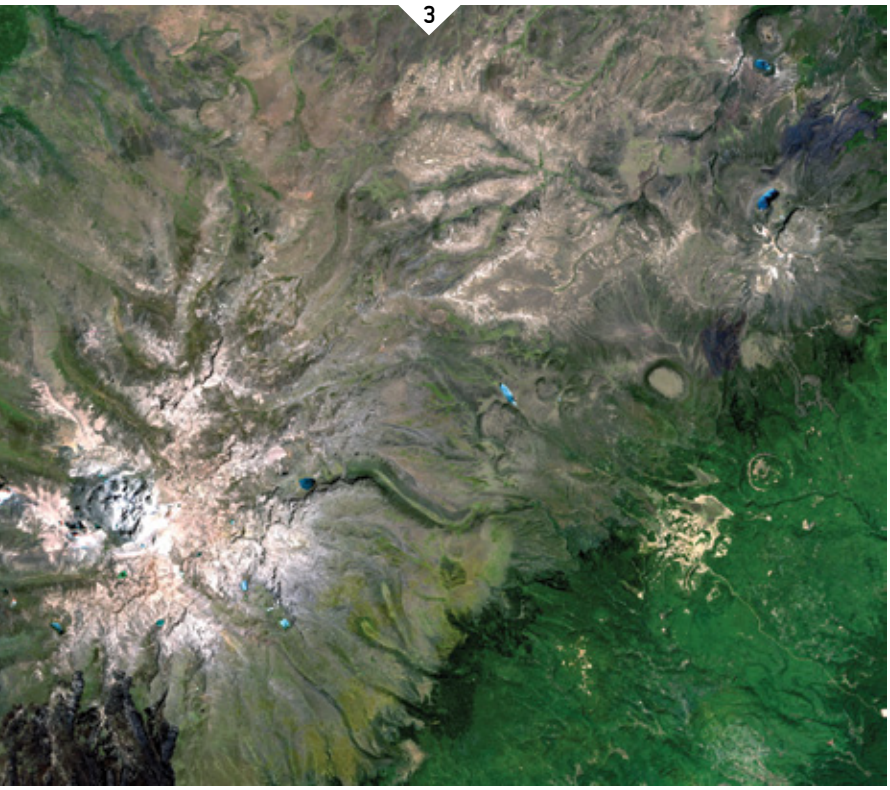
that available to our users through the same toolset that they use to access the RapidEye data. We see a lot of demand for this multi-source imagery, and we want to make it easy for our users to access not just RapidEye data, but any other data that is relevant to their project.

▼ FIGURE 3.
Mt. Kenya, collected February 2, 2012

▶ FIGURE 4.
Cape Cod, Nantucket and Martha's Vineyard, Massachusetts, U.S., collected July 14, 2012

S&S *It's a fascinating evolution. Access to the data, and even finding data when you know you already own it, has been an ongoing problem that seems to have been holding geospatial solutions back for some time, and now the flood gates are open.*



SOENEN That's really the impetus for a lot of our development work, creating tools for our partners and customers that make it easier for them to search our archive and discover data, but also to find our data and process it in the cloud as well. With our cloud services, we provide a means for the customer to leverage our knowledge and our purchasing power on the cloud services side, removing the data management and capital expense of servers so that they have a monthly bill that they can easily plan for, from a budgeting perspective, and also making it very easy to use.

S&S *There is a set timeline for any satellite in space. Are there continuation and contingency plans should one or more satellites in the constellation fail?*

SOENEN We're already deep in the process of planning our next generation of satellites. There isn't much that I can talk about publicly at this point, but we're well down that path and will be providing details to our partners this year.

S&S *There are a growing number of small satellite makers, and a growing number of commercial satellite imaging companies. Does the growth in the market help in getting a better price? What are your feelings about the evolving competitive landscape?*

SOENEN I think it's a bit too early to tell. The number of options for bringing Earth observation missions to market are growing, and certainly the maturity of some of these technologies, methods and processes are really getting very interesting at this point. You could say that the original RapidEye constellation was one of the first commercial providers to take this small-sat approach. The platform is small, and it was done with a low-cost small satellite philosophy, and was innovative in launching one of our qualification models as a protoflight payload. A lot of these techniques are what some of the other small-sat providers are doing these days to reduce costs and bring their missions into orbit.

S&S *Could you speak a little about the current capacity of your current satellite constellation? Certainly, it's well documented in terms of your global coverage, and the imagery that you can collect, but maybe speak to the uniqueness of your collection capacity.*

SOENEN We have a system that is very unique in the market in terms of its capacity, both on the broad swath of the satellites, and our ability to do daily revisits. Both with the collection capacity and the imaging system, we have one of the best systems for broad-area mapping and change monitoring. There really isn't anything in the market that you can compare it to right now. This becomes really important when it comes to looking at some of these applications like change monitoring at a global scale.

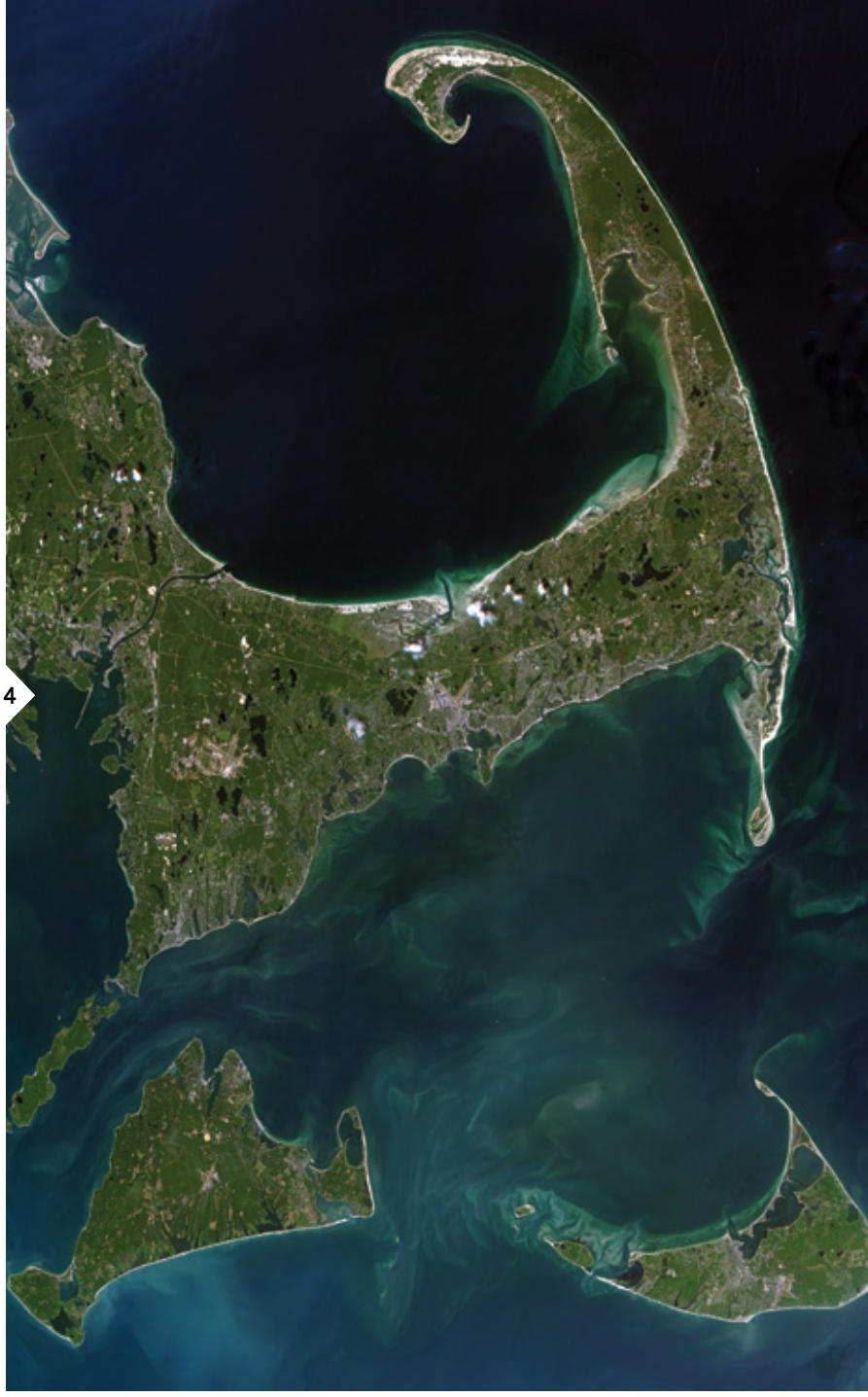
It's really interesting to see these new players like Skybox and Planet Labs. We're very excited about seeing these new potential partners, or seeing in what ways users can leverage the different data sources. They could use our imagery for identifying areas of change, and then using these new low-cost, high-resolution platforms to focus in, they could collect video or still images of these areas where we've identified change. The potential to use some of these multi-source imagery sets is huge, and I think it will introduce some exciting new applications in the industry as well.

S&S *I get really excited about the capacity for discovery. There are so many mind-blowing discoveries that come from Earth observation, more with every new satellite-based sensor, and certainly more on the way given our capacity to monitor our planet.*

SOENEN We're going to continue to focus on the capacity for broad-area mapping, as we see a real niche in the market for that. We're really interested to see how users will combine our capabilities with other players.

S&S *With your ties to broad-area mapping and detecting change, is the demand for monitoring keeping up with global concerns about limited resources and our need to better manage our planet?*

SOENEN We're very well positioned in that. Our system is ideally suited for some of these global change applications. One of the ones that we like to highlight is the UN REDD+ Program (Reducing Emissions from Deforestation and forest Degradation). That forest change detection application within the monitoring, recording and validation (MRV) initiative through the REDD program is one spot where RapidEye imagery really shines. It is one of the only systems that you can use to look at an entire country and see where there is change occurring through deforestation and degradation. The other advantage about our system is the spatial resolution, as it allows for monitoring the degradation component, which is almost impossible to assess with coarser resolution systems. We're starting to see a lot of governments looking at these types of initiatives and becoming more responsible about their own environmental management.



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Our archive is a very interesting asset, particularly when we look at some of these change applications that need to go back to a baseline, which for us goes back to February 2009. We have one of the most comprehensive global monitoring archives out there, and we can continue to apply new methods and processes to deliver new information about the past and present.

The Netherlands

The Forefront of Geospatial Data Management

BY MLADEN STOJIC
PRESIDENT / HEXAGON GEOSPATIAL
WWW.HEXAGONGEOSPATIAL.COM

THE NETHERLANDS IS A PROGRESSIVE COUNTRY that embraces geospatial solutions in innovative ways. From digitizing massive volumes of historic imagery to embracing 3D data for monitoring the changing landscape, it is home to many forward-thinking organizations that are bringing the power of spatial solutions to the forefront.

Key drivers for this are the requirements of local and national government agencies and private sector organizations, who are all continually striving to make sense of their dynamically changing world and respond in appropriate ways. With 20% of its area below sea level and 50% of its land lying less than a meter above sea level, the Dutch are used to needing cutting edge answers to challenging problems. They know how to manage and understand a drastically changing landscape, all while ensuring sustainability.

Likewise, the Netherlands' history is firmly tied to the wind. The Dutch are famous for using the wind to power many industrial purposes, and because of that, the windmill is firmly considered an iconic emblem of that country. Historically, wind has powered everything from grist mill operations to pumping water out of areas below sea level. Possibly more than any other nation, Holland has always understood the extensive power of harnessing this natural raw energy.

The wind is a catalyst for change—and demands a response. However, the wind is often uncontrolled, and can be confusing or even frustrating for citizens and local government organizations. In a similar vein, the massive influx of disorganized spatial data can be overwhelming for any organization. Raw data has tremendous potential to be useful, but must be controlled, organized, and synchronized to produce information.

Many organizations in the Netherlands are seeking the best tools and innovations available to best leverage volumes of geospatial data. Those organizations understand the reality that, while we live in a data-centric world, information must be interpreted and

customized in order to be useful in driving effective decision making. This is the foundation for today's geospatial solutions.

PROVIDING HISTORIC IMAGERY TO CITIZENS

The most forward-thinking companies understand that the only place to start is to organize data into one human-readable library. Dotka Data is one of them. A Netherlands-based services company, Dotka is creating a comprehensive, historic time-series library of maps and imagery covering over 200 years of Dutch history. The archive is formed by digitizing archives of aerial photographs and maps into digitally re-mastered and georeferenced databases for online distribution. To date, Dotka has digitized and exploited more than 60 Terabytes of geospatial data.

An impressive collection, the Dotka Data imagery archive includes topographic maps from as far back as 1798, and aerial photographs taken for topological purposes from 1932 to the present. Due to the age and breadth of the information in the collection, it offers a unique perspective on major changes and events in Dutch history. As an example, this data showcases the development of the Netherlands' many polders (areas of reclaimed land), the location of unexploded shells from World War II, and the urban expansion of the 1970s.

In taking this effort to the next level, Dotka Data has developed a new e-Commerce extension and online store. This interactive solution provides visitors a means for discovering and purchasing, on-demand, these massive collections of imagery and vector datasets of the Netherlands.

The e-Commerce API that Dotka Data developed leverages ERDAS APOLLO technology, and includes three Webshop templates for accessing data as original photos, mosaics, geodata or PDF reports, all available for print or download.

According to Wouter Brokx, co-founder of Dotka Data, whether it is a sensor owner, data broker or a print media organization, the new API framework enables these organizations to quickly start exploiting large volumes of imagery and vector data in multiple Webshops simultaneously.

In addition, the e-Commerce API allows these organization's customers to easily select, order, pay and receive geospatial information products made for on-demand use by content owners. This mechanism makes it possible for data owners to increase exposure of their content and ultimately drive revenue by adding new services into existing markets and new consumer markets.

The Webshop client templates essentially allow data vendors the ability to offer geospatial information to consumers and professionals with compulsory authorization. The Dotka platform currently supports the following shops:

- **Dotka Originals:** These are original photographs in the form of framed camera scans that are available for download and print.
- **Dotka Mosaic:** These images are subsets cropped from georeferenced mosaics, and are available for both download and print as well.
- **Dotka Report:** This is automatic PDF creation and optional TIFF/SHAPE delivery of all selected layers including metadata, which is delivered within 15 minutes.

In 2012, Algemeen Dagblad (AD), one of the largest Dutch newspapers, contacted Dotka early on to provide a free set of aerial photographs from 1960 and 2011. In six weeks, the organization served over 15.9 million previews, which is an incredibly high number considering the population for the Netherlands is only 16 million. The conversion rate of this effort was 15 percent of the AD readers, with an up-sell of 28 percent including a total of 189,000 high-resolution prints sold.

Powering all of this data organization and dissemination on the back end is ERDAS APOLLO. This enterprise-class data management, analysis, and delivery system enables any organization to catalog, search, discover, process, and securely disseminate massive volumes of file-based, database and web-enabled data.

Essentially, this solution allows any organization to manage and make sense of volumes of disparate data. Geospatial data that is distributed across multiple departments or offices can be easily organized and disseminated via a variety of different ways. ERDAS APOLLO also makes it easy for organizations to facilitate a central imagery repository while minimizing infrastructure and management overheads. The catalog is powerful enough to organize any data type in the enterprise, including business data, into one comprehensive, human-readable library.

CLEARING EXPLOSIVES USING SPATIAL DATA

The explosive legacy of the Second World War is a growing social problem across Europe. The Netherlands endured a tremendous amount of bombing during WWII and, while most of these munitions exploded, in many cases they did not. Over the decades since, many unexploded ordnance have unintentionally become buried in farm fields and even dangerously hidden under new construction in the hearts of big cities. These older military ordnance become more sensitive to disturbance as they degrade over time, and pose a real risk of detonation. As recently as 2012, an unexploded WWII bomb was found under Schiphol, Holland's busiest airport, requiring a large evacuation until the bomb was safely removed.

▶ FIGURE 1.
One of Dotka's early non-GIS customers poses here with a framed picture of her house and neighborhood. Initially focusing on the consumer market, Dotka became a popular site for accessing maps and historic imagery for areas of interest.

Dud explosives that failed to fire on contact are still unsafe and are often found through regular excavation and dredging. In fact, each year more than 3,000 explosives are discovered and cleared from the Dutch soil. With an ever-growing human footprint across Dutch lands, this is a potential danger that could cause tremendous harm to citizens.

To reduce the risk of human encounter with these unexploded bombs, Leemans Construction & Explosive Clearance conducts extensive research. Their core expertise is in properly locating explosives in the ground, even when the human eye can't see them. Leemans has found a unique means of achieving discovery—historical photos used as the foundation for locating explosive devices, even for those that are hidden from the human eye.

Historical photos offer a clear picture of a time gone by. Through photo research, Leemans can unearth interesting information, for example where former buildings once stood. They can also determine the exact location of events or acts of war, which were previously unclear.

Most importantly, these images serve as the foundation for discovering new facts. Take, for example if a large bomber was hit during the war, an emergency landing may have also occurred. Prior to putting the aircraft on the ground, the onboard bombs would typically be discharged, which usually happened over water or uninhabited areas such as meadows. These types of bomb drops were not reported in the logs, but the bombs scar the land. Often, aerial photographs are the only witnesses of such occurrences and can reveal unique patterns in the soil. Before and after images of a raid show a world of difference.

To achieve this, Leemans Construction & Explosive Clearance makes use of solutions for performing advanced remote sensing analysis and spatial modeling. With this technology, they create new information and visualize results in 2D, 3D, movies, and on cartographic-quality map compositions. Ultimately, this advanced solution provides deep insights needed for combing areas for unexploded ordnances.

COMPREHENSIVE GIS, REMOTE SENSING AND PHOTOGRAMMETRY IN NIJMEGEN

Located near the German border, Nijmegen is considered to be the oldest city in the Netherlands and recently celebrated its 2000th year of existence in 2005. With nearly 166,000 inhabitants, the city also is home to 15,000 students from Radboud University, which gives this location a very unique and progressive character.

As such, the population is also very spatially aware, and the municipality embraces projects that combine GIS, remote sensing and photogrammetry tools to provide a breadth of analysis potential to apply to an ever-changing landscape.

Today, the Nijmegen municipality uses ERDAS IMAGINE and IMAGINE Photogrammetry, along with GeoMedia, to deliver relevant and accurate GIS information for multiple projects. The organization is forward thinking in its endeavors to integrate image and point cloud data archives for better overall analytics for environmental impact studies, habitat monitoring, green space monitoring, impervious surface

mapping, urban planning, roadway management, and emergency planning.

While the municipality may engage in analytics that involve complex spatial modeling and analysis, the insights it provides must be easily consumable by someone who is not a GIS professional. The municipality is heavily focused on how it communicates the results of their powerful processes to citizens and organizations alike, all who utilize this information to make their own critical decisions.

MOVING FROM 2D TO 3D

It is common for many municipalities around the world to do their work completely in 2D. Nijmegen, however, is embracing 3D as a method for enhancing data delivery to citizens in a more dynamic way—resting on the belief that citizens want to fully connect what they are seeing on an application to what they truly experience in real life.

The municipality is currently leveraging Hexagon Geospatial's platform of technology to develop innovative 3D change detection applications. It is in the process of creating a connected experience for its users, enabling them to stitch together different commands and models and visualize results in 3D.

It is clear that the Netherlands is a country that embraces the true value of geospatial—not only for enterprise operations, but also for enhancing services to its citizens. From leveraging historic imagery to providing a wide array of municipal-level solutions, there are many viable examples of the geospatially forward approaches the Netherlands takes on a regular basis.

Hexagon Geospatial will be showcasing a number of these stories at HxGN Live 2014. In the breakout session titled "E-Commerce for Massive Data to the Millions," insights will be shared about the Dotka e-Business model. In the "Point Clouds for 3D and 4D Change Detection – From Building Assessment to Water Flow" breakout session, we will show attendees how making use of data-rich point clouds provides a huge benefit for organizations, from updating building footprints for base registrations and taxes, or to detecting changes in terrain for water flow control.

In the meantime, we recommend everyone keep their eye on this unique nation, as it will continue to remain on the forefront of innovation and use geospatial data in ways that truly transform how it operates and serves its citizens.

LOCATION TRACKING USING RFID

New Research Promises New Applications

BY MICHAEL PERRAULT
WRITER / DENVER, COLO.

A newly patented invention that precisely tracks mobile phones, tablets and other radio frequency-emitting devices (RFID) indoors could help redefine the possibilities for everyone from retailers and marketers to airlines, car manufacturers and municipalities.

The possibilities due to tracking within inches, in three-dimensional (3D) space, in real time are incredible. "It's really difficult to fathom all of the applications," said co-inventor Christopher Price, who worked with longtime electronics engineer Gregory Beveridge on the technological discovery. "At no point in history have you had everybody walking around carrying a beacon announcing a unique presence in every space. That's not going to change." The two inventors at Denver-based Prima Research LLC have spent several years developing and refining what they believe is an innovative, cost-effective and practical solution to more accurately identify and track mobile devices indoors compared to other current methods.

Price said one example of how his emerging company's technology could be used would be for car manufacturers to create a defined space in the driver's seat of a vehicle that would prevent cell phones from ringing or dialing out. Passengers could continue to use their mobile phones as they desire.

Similarly, a movie theater chain might employ the technology to disable cell phone texting and calls inside theaters, potentially alleviating tension and arguments—or even violence—among moviegoers.

Ocean shipping lines could attach radio frequency identification tags to cargo and use Prima Research's method to automatically catalog contents as they're packed into containers. The contents could be correlated en route or as the ships come into port, helping eliminate delays, Beveridge said. "If we could shave two days off the transit time, that's worth billions of dollars to (a shipping company)," he said. It could feasibly also provide more security.

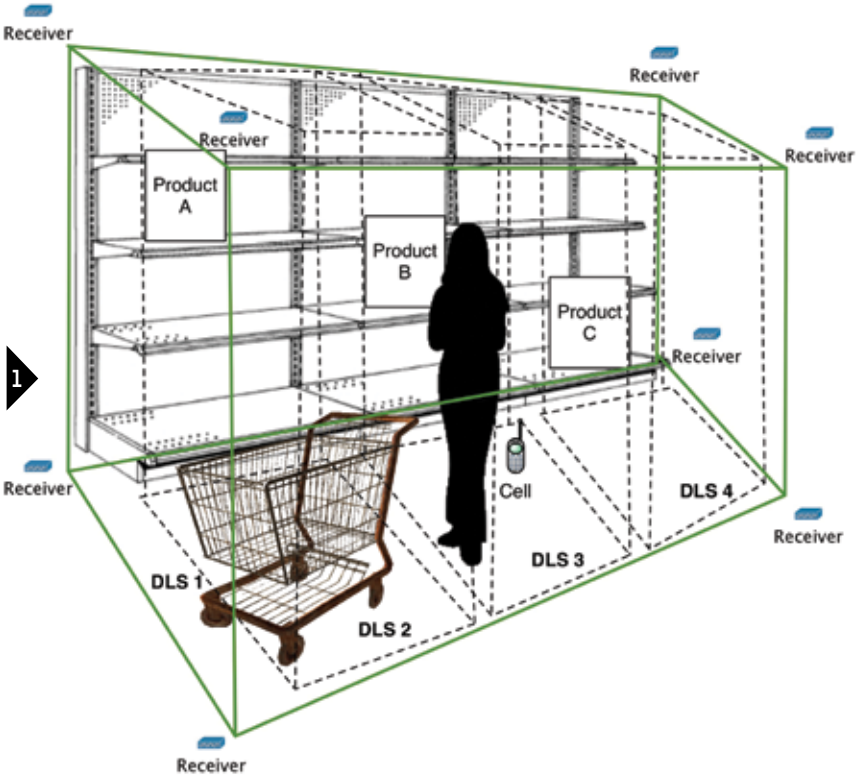
Prima Research's approach involves a network of receivers arranged to encompass a 3D space. The receivers track any radio frequency-emitting devices in places such as shopping malls, airports, sports arenas, conference centers and corporate campuses.

Initially, Price said the company is focusing on potential applications in the nascent indoor location-based services market, which Stamford, Conn.-based Gartner Research estimates will grow to $20.6 billion by 2015.

"For the first time, marketers have the ability to continuously observe consumer behavior in real time in a defined space with a sample rate typically better than 90%; no special apps, devices or individual engagement is needed," Price said.

THE STRATEGY

Prima Research's initial strategy is to license its invention to wireless service providers, platform manufacturers and integrators, and other practitioners such as inside mapping entities that require location data. Its technological solutions are being offered to help companies in the telecommunications sector and their suppliers bring new services to customers.

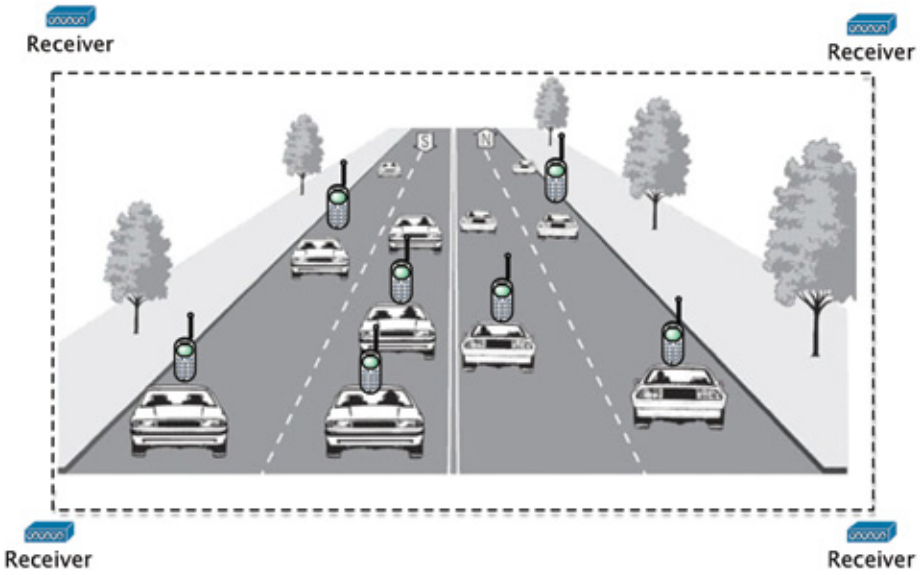


◀ FIGURE 1. Retailers and marketers could employ Prima Research's technology to discreetly track and observe consumer behavior.

In recent years, much of the buzz in the indoor location-based services industry has been about creating technologies that allow retailers and marketers to directly track and observe consumer behavior.

"Companies in retail, hospitality, transportation, healthcare and other industries that have a strong emphasis on physical infrastructure are increasingly turning to location technologies as a means to improve their customer services," Costa said. Retailers will be able to better engage shoppers in real time as they stroll down aisles. They will learn answers to questions such as, "how long did they stop, at which store, on what aisle?" Beveridge said.

Indoor positioning will make it possible for consumers to use their mobile devices to search for products and objects in the physical world as easily as they can via the Internet, said Tony Costa, senior analyst with Cambridge, Mass.-based Forrester Research. Advertisers will present consumers with immediately relevant display ads, coupons, or offers to deliver personalized services, in the store, based on where the customer is actually standing. See ***Figure 1***.



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▲ FIGURE 2. Municipalities could accurately and precisely track vehicles and create traffic control systems that route traffic according to real-time conditions.

TURNING IDEA INTO INNOVATION

Before helping to launch Prima Research, Price spent years as an independent management consultant to the telecommunications, call center, online retail and other industries and was a senior strategist and team leader for AT&T Broadband (now Comcast). He earned an MBA in entrepreneurship and venture management from the University of Denver and is now also vice president and chief operating officer for Bright Beginnings, an early childhood development nonprofit.

Beveridge spent nearly four decades as a senior executive in the telecommunications industry, including years as chief of technology for US West International (now CenturyLink). Beveridge was working as president of his own consulting firm when he began collaborating with Price.

Beveridge referred to Price as "the idea generator," while he was the "technical person who understands how it works." The two men spent many nights, month after month, working on their innovation, sometimes challenging one another. "It was wonderful and exhilarating, and what you see is the result of that," Price said of the invention process.

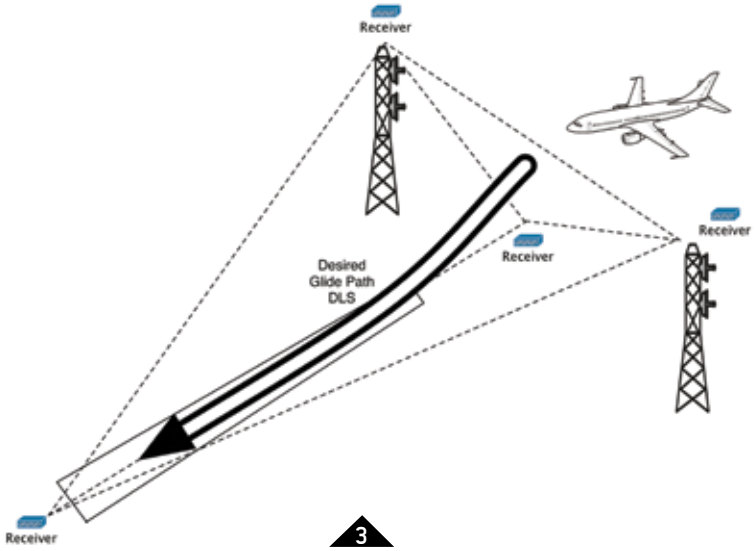
Others working with Price and Beveridge to develop and market the technology include strategist Chris Beveridge (Greg's brother), who has spent more than 25 years in the telecommunications and networking technology, principally with Cisco Systems; and engineer James O'Connor, principal with JPO Wireless Consulting LLC, who is providing engineering consulting services in systems design. Developer Michael Cain, who began his career with Bell Labs, is providing mathematical, computer science and public policy expertise.

What sets Prima Research's approach apart from other location systems are its ability to locate wireless devices in a mathematically defined 3D space, relatively low cost and ubiquity, Beveridge said. The company's multi-receiver platform arranged in three dimensions eliminates the possibility of "aliasing" and false reporting, Beveridge said.

Price and Beveridge said the previous focus of other efforts on traditional two-dimensional locating methods is because most prior applications—such as locating airplanes, ships or people during emergencies—are plotted on a two-dimensional map.

But using two-dimensional methods to accurately locate radio frequency-emitting devices inside buildings is more difficult and less precise because satellite global positioning signals (GPS) aren't reliably available inside buildings. In recent years, people have widely relied on GPS for location information about cell phones and other mobile devices. But GPS, which requires a clear view to communicate with satellites, doesn't work well in indoor spaces or "urban canyons," where streets cut through dense blocks of high-rise buildings and other structures. GPS signals can become attenuated or scattered by roofs,

▶ FIGURE 3. Inventors at Prima Research believe their method could provide the Federal Aviation Administration with a much-improved method of controlling and directing air traffic, increasing efficiencies and enhancing public safety.



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walls or other objects.

In terms of cost, the method can be implemented using off-the-shelf radio-frequency receivers and a typical, conventional computer to collect and analyze the received signals and determine location, Price said.

Prima Research's solution was developed with existing wireless network mobile devices in mind. The technological solution can be implemented using any modulated radio frequency signal from any radio-frequency-emitting device. The primary device may be a mobile phone, but any device that emits radio frequency signals can be detected—tablets, computers, radio-frequency identification tags, and in any mobile device frequency band such as WiFi, 3G, 4G/LTE, or unlicensed systems. Most systems used today are limited to WiFi, or just cellular.

PRIVACY CONCERNS

Beveridge and Price see Prima Research's approach as anonymous locating and sampling, which should quell concerns about communications privacy for individuals and their information. They liken it to being counted as part of a crowd-size estimate being made by someone with a mechanical "ticker" as anonymous individuals enter a building or room.

Price said mobile devices don't transmit or embed any direct or encoded names, phone numbers, addresses or any other private information in a radio frequency signal. "The per-device unique digital ID sequence is also arbitrary from our perspective," Price said. "The Prima method creates no means of associating that device with any private individual whatsoever. Restrictions on this sort of data-monitoring are a matter of law and agreed-upon terms between the service provider and each mobile device customer."

AN ARRAY OF OTHER APPLICATIONS

The potential uses of indoor location-based services for retailers have caught the attention of many tech heavyweights such as Apple, Broadcom, Google, Microsoft and Nokia. They're working to extend the capabilities of their products and platforms to enable indoor positioning.

Prima Research sees retail and marketing as a key sector but wants to avoid being defined solely by those applications. "Tracking whether a user enters one space or another is a very elementary application," Price said.

Commercial property managers could track traffic patterns and shopper behavior, possibly adjusting lease rates based on the data. Its technology could help create applications and systems for real-time mapping and location of goods in retail stores.

The technology could be used by first responders to locate victims. Police could discretely track and observe persons of interest. Price and Beveridge said their approach might be used to track mobile phones at events such as the Boston Marathon, possibly deterring crime such as the two bombings that occurred on April 15 last year.

Municipalities could determine traffic or crowd patterns minute-by-minute or create smart traffic control systems that route traffic based on real-time conditions. See ***Figure 2***. The Federal Aviation Administration would have a much-improved method of controlling

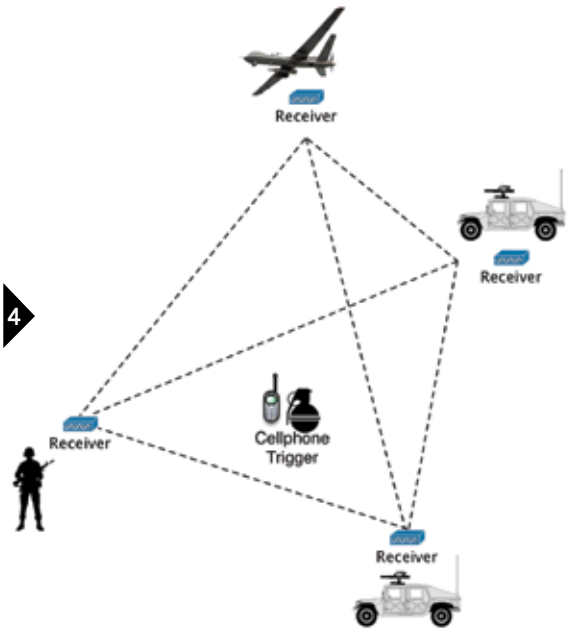

FIGURE 4. Prima Research's three-dimensional approach to tracking radio frequency-emitting devices could help military planners make more educated decisions about the location of primary and secondary targets as well as for determining the potential collateral damage, company officials said.

and directing air traffic, increasing efficiencies, saving time and improving public safety, Beveridge said. See ***Figure 3***. Military planners can make more educated decisions about the location of primary and secondary targets as well as for determining the potential for collateral damage. See ***Figure 4***.

Price is adamant that the invention's potential goes far beyond indoor location-based services and marketing applications. "ILBS is hot right now because marketers are so close to it; the pain of working with solutions that are so close to, but not quite working as they want, has created a bit of a frenzy. However, when other sectors start to understand the possibilities, they will introduce many truly novel, market-disrupting, real-world solutions. Our work is going to help smart companies rethink what is possible." ∧○

Calm Technology

Inspiring Developers and Digital Citizens

BY NATASHA LÉGER / EDITOR / *LBX JOURNAL*

Technology innovation is an evolutionary process where new products, solutions, and ideas are built on the theories and inventions of those who came before us. Mark Weiser, John Seeley Brown, and Rich Gold worked together at one of the nation's most advanced technology labs—Xerox PARC. They introduced the idea of calm technology, but with each generation of technology innovation, things get forgotten. Mark and Rick passed away; John is now the only survivor of this trio.

Amber Case has made it her mission to tell their story, and make sure that their perspectives on seamless communications and preserving personal privacy in an age of connected devices and real-time information is not lost. Case is now the Director for Research and Development at Esri, and blogs regularly at caseorganic.com. She has launched the calmtechnology.com website as a tribute to these great minds and to inspire software developers on the relationship between ubiquitous computing (connected everything) and people (privacy, expectations, perceptions).

Editor's Note:
This interview is also being published in Location Media Alliance partner *LBx Journal*. *An additional interview is on video at www.geospatialstream.com/?p=563.*

WHAT IS CALM TECHNOLOGY?

Technology has become disconcerting to many people because of its complexity, and speed. Information technology is more often the enemy of calm as we are bombarded with pings and alerts. Some devices are intimidating because of the way they are designed, others because of their perceived level of information collection. But it doesn't have to be that way. Mark Weiser and John Seeley Brown believe the difference in whether we perceive technology as agitating or calming is in how the technology (devices) engage our attention. "Calm technology engages both the center and the periphery of our attention, and in fact moves back and forth between the two," said Weiser and Brown in an October 5, 1996 Xerox PARC research paper titled "The Coming Age of Calm Technology."

The idea behind calm technology is to have smarter people, not things. Calm technology is a people-centric framework for developing digital products and services. It's not an acronym, so it doesn't stand for anything. It is a descriptor of how people should feel when they are interacting with technology. People shouldn't feel anxious, worried, stressed, oppressed, spied upon, disempowered, agitated, or any of the many other adjectives used to describe the plight of the digital citizen today. Instead people should feel liberated, confident, empowered, relaxed, and in control when it comes to embracing the connected world.

Amber Case

Amber Case is the Director of Esri's R&D Center, Portland, Oregon, where she works on next-generation location-based technology. Previously, she co-founded Geoloqi, a location-based software company acquired by Esri in 2012. She recently worked on MapAttack!, an urban geofencing game based on Esri technology.

In 2012 she was named one of *National Geographic's* "Emerging Explorers" and made *Inc. Magazine's* "30 under 30" with Geoloqi co-founder Aaron Parecki. Case has spoken at TED on technology and humans, and regularly speaks around the world. You can follow her on Twitter @caseorganic or at caseorganic.com.

Calm by design has three main characteristics:

- to be everywhere,
- to be small, and
- to be aware.

"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it," Weiser wrote.

Location data is at the heart of a connected world. Location data is what allows all of these "things" to be connected; it is what stitches together the fabric of our daily lives. Yet, like many things in life, when the data, technology, and solutions are misunderstood or misperceived, they create a backlash to the anticipated outcome.

Location data, when properly stewarded, will unleash all of its promises. Herein lies the role of Calm Technology. It is a framework for understanding our relationship with technology, and most importantly a development framework to inspire computer scientists and software developers.

WHO DEVELOPED CALM TECHNOLOGY?

Mark Weiser, Rich Gold and John Seeley Brown were at the beginning of exploring how our everyday lives would work in the future. Together and with others at Xerox PARC, they explored the future of the interface and society, and they created a miniature implementation of the future. Their work is an inspiration for all of us in the computer science field, as well as a lens and building block for determining how to develop new connected devices and information systems in an increasingly complex technology world.

WHY IS CALM TECHNOLOGY IMPORTANT FOR THE FUTURE?

Amber Case has been on the speaking circuit explaining the past, present, and future of calm technology. In particular she discusses how the same topics, issues, or technologies evolve with different names over time. For example, there have been many different marketing terms for ubiquitous computing over the years: from mainframe to grid to cloud computing, to M2M (machine to machine) to Internet of Things (IOT).

Calm technology is about the seamless communication of devices and ease of interaction between man and machine. Today all the sensors and networks are in place to realize the vision, but the systems all have different protocols.

Currently, there is no easy way to connect devices. In other words, devices can't communicate with each other because the technology landscape is so fragmented. The smartphone or tablet is increasingly working as the hub to connect various devices. We know this as an app that allows you to read sensor information from other devices installed in the home, such as the Wink or Nest, or out in the field, such as temperature and humidity sensors. But getting your Smartband to talk to your coffee machine is a whole other story.

There are efforts underway (such as AllJoyn) to develop a common language for the Internet of Things. AllJoyn is an open-source project

developed by Qualcomm to standardize protocols to enable devices to seamlessly communicate with each other.

As devices become more connected, and information shared between devices about people's behavior in the physical world are shared at an unprecedented scale, privacy protection and privacy management becomes ever more important. The design of technology influences how people perceive it. There has been a backlash on Google Glass because it just "feels and looks creepy." However there are devices such as the Narrative Clip, which is an automatic camera and app that captures your day in photographic memory. It is similar to Google Glass in that it is watching and capturing images of others around you, but it is inconspicuously designed such that it doesn't "offend" others. Or perhaps, the reality is that people just do not realize that they are being photographed.

The Clip takes 5 megapixel pictures every 30 seconds, connects and uploads pictures to your private library in the cloud. The photos can then be shared, searched and analyzed by algorithms into groupings and ranked according to relevance and importance.

What makes Narrative Clip different from Google Glass is that it was developed according to the calm technology framework. As Amber Case said, "it's small, the eye is off center, it has curved edges; it doesn't look scary." With Narrative Clip, while it snaps pictures every 30 seconds, you get to control when the data is uploaded and shared.

INSPIRING DIGITAL CITIZENS

The NSA surveillance of ordinary citizens has demonstrated how insidious our connected world has become. To many, this was less news than shock at the scale of the blanket spying. However, computer scientists like Amber Case give us hope for a different kind of digital future: a future where individuals own and control their data; a future where technology is truly liberating and inspiring. Technologists, unconstrained by business models and investment expectations, can make this future a reality. What is clear is the digital economy that supports calm technology has not yet evolved, but I look forward to that world.

> "Location data, when properly stewarded, will unleash all of its promises. Herein lies the role of Calm Technology."

Check out calmtechnology.com for research papers on calm technology from the early days at Xerox PARC, examples of calm technology products, and plain old inspiration. Also see Wikipedia for more recent articles on integrating the calm technology framework into education technologies, mobile computing, and more.

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